OTHMER LUNCHEON (see page 11)

CHEMICAL HERITAGE

VOLUME 11 ■ NUMBER 1 ■ WINTER 1993–94

BIMOSI Conference on Biotechnology

The connections between biotechnology —an industry that offers a world of promise—and molecular biology—the result of an intellectual revolution—are becoming the subjects of lively debate. That debate is one natural focus for CHF's Biomolecular Sciences Initiative (BIMOSI), and as this issue of *Chemical Heritage* went to press, finishing touches were being put on plans for an ambitious BIMOSI conference to address the issues involved. "Private Science: The Biotechnology Industry and the Rise of Contemporary Molecular Biology," is being held 28–30 October 1993, at the Eagle Lodge Conference Center in Lafayette Hill, Pennsylvania.

Some twenty historians of the chemical sciences, sociologists, and political scientists plan to review the transformation of molecular biology, from an academic endeavor whose goal is to elucidate the obscure processes guided by that remarkable polymer, DNA, to a corporate commodity of significant agricultural and medical value. The opening session, "From Beer-Brewing to Biotech," features Robert Bud of London's Science Museum and Daniel J. Kevles of Caltech; it provides a historical framework for studies of molecular biology, addressing the changing roles of patrons, researchers, and intellectual property. Later sessions (including "Setting Styles for Research," "Strategies for Building the Biotech Industry," "The Molecular Workplace," and "The Human Genome Project") include Pnina Abir-Am (Johns Hopkins), Angela

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The Commonwealth of Pennsylvania placed a historical marker at the Joseph Priestley House in Northumberland. Courtesy James J. Bohning.

CHF Salutes Historic Chemical Landmarks Program

HERBERT DOW'S FIRST PRODUCTION SITE in Midland, Michigan; the Solvay Process Company in Syracuse, New York; the Joseph Priestley House in Northumberland, Pennsylvania—all are landmarks of the chemical sciences in the United States. Thanks to the Commonwealth of Pennsylvania, a historical marker now appears in front of Priestley House. The Dow Historical Museum occupies a replica of Dow's original factory building. And efforts to preserve Solvay's past are well under way (see p. 17). But hundreds of chemical sites that profoundly influenced American history remain unrecognized and unknown, a neglect that reflects a general ignorance of our chemical heritage.

The ACS Division of the History of Chemistry (HIST), in cooperation with the ACS Office of Public Outreach, has launched the National Historic Chemical Landmarks Program (NHCLP) to right the record. The program will identify and document chemical milestones—sites, artifacts, or collections—around the country. Projects like the Dow Museum and the Solvay collection—or Rensselaer's Winslow Chemistry Laboratory in Troy, New York (see *Chemical Heritage* 10:2, Summer 1993, p. 25)—make likely candidates. The Priestley House has already been nominated. The goal is to

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CHEMICAL HERITAGE FOUNDATION

The Chemical Heritage Foundation (CHF) was established by joint action of the American Chemical Society and the American Institute of Chemical Engineers. Affiliated organizations include Alpha Chi Sigma, The American Association for Clinical Chemistry, Inc., the American Association of Textile Chemists and Colorists, the American Institute of Chemists, Inc., the American Society for Biochemistry and Molecular Biology, the American Society for Mass Spectrometry, The Chemists' Club, The Electrochemical Society, Inc., and the Société de Chimie Industrielle.

CHF seeks to advance the heritage of the chemical sciences by discovering and disseminating information about historical resources; encouraging research, scholarship, and popular writing; publishing resource guides and historical materials; conducting oral histories; creating traveling exhibits; and taking other appropriate steps to make known the achievements of chemical scientists and the chemical process industries.

CHF operates through public outreach programs and through the Arnold and Mabel Beckman Center for the History of Chemistry and the Donald F. and Mildred Topp Othmer Library of Chemical History.

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Ionic Conducting Polymers—Born Twenty Years Ago

In the CHF brochure Electrochemistry: A Science at the Interface *the time chart lists Peter V. Wright's discovery, in 1973, of ionic conducting polymers. David E. Fenton of the University of Sheffield here tells the story of that discovery.*

When I completed my postdoctoral studies at Cornell and SUNY at Albany, I returned to the United Kingdom and joined the Unit of Structural Chemistry of the Agricultural Research Council (ARC). There I was introduced to cyclic polyethers through Mary Truter, who solved the crystal structures of Charles Pederson's crown ethers and their alkali metal complexes.

In 1973 I moved to the University of Sheffield and shared a house for a few months with Peter Wright, a new lecturer in the Department of Ceramics, Glass Technology and Polymers. In the evenings we would sit and talk, and we soon discovered that we had a common scientific interest in that Peter had studied the siloxane ring-chain equilibrium and I had been involved with macrocyclic polyethers. Peter wondered whether the siloxanes might complex the alkali metals and whether the polyethers also underwent a ring-chain equilibrium. I told him that the latter did not occur, but it was possible to find acyclic polyethyleneglycols, and they should readily complex the alkali metals. Behind this was the thought that either of these systems might lead to solutions with interesting electrolyte properties—and of course to the eventual isolation of crystalline alkali metal complexes of the polyethyleneglycols. For these I predicted, from my ARC experience, that the structures would derive from helical ligand arrays with the alkali metals encapsulated in the helices and the anions in channels, and thus well separated from the cations.

We made such complexes, and Peter invited one of his colleagues, John Parker, to look at the crystals. He established the repeat number, and we were happy to have the result that we had predicted. If the anions were free, then the crystals should conduct electricity. The relevant experiment showed that

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NEWS from the Arnold and Mabel Beckman Center for the History of Chemistry

The Beckman Center is sponsored by the Chemical Heritage Foundation and the University of Pennsylvania. The Center is an academic unit of Penn, working closely with the Department of History and Sociology of Science and with the Departments of Chemistry, Chemical Engineering, and Biochemistry and the Laboratory for Research on the Structure of Matter. The Center's mission is to undertake scholarly research, publish materials on the history of the chemical sciences, support senior-level and graduate fellowships, and conduct a variety of scholarly events of interest to the academic community.

BIMOSI: Guide to the Human Genome Project

The Human Genome Project (HGP), endlessly in the news and in scientific and policy discussions, mystifies not only the general public but even those—journalists, decision makers, teachers—who are desperately in search of a broad overview and quick reference. This "big science" project bridges chemistry and biology and impinges on numerous areas of public concern. Elizabeth Hanson and Susan L. Speaker, graduate assistants at the Beckman Center, assisted by Professor M. Susan Lindee, have now produced *A Guide to the Human Genome Project: Technologies, People, and Institutions* as part of the Center's Biomolecular Sciences Initiative (BIMOSI).

The *Guide* begins with a survey that first describes the initial stages of HGP in the United States, with the Department of Energy and National Institutes of Health as key players. The survey touches on genome research abroad and on HUGO, the international Human Genome Organization, which coordinates and facilitates exchange of data, biomaterials, and information. The section ends with "Pros and Cons," covering the debate about whether we should fund this big and perhaps bad science venture, and about what the role of patents should be.

"Technologies and Techniques" describes DNA molecules, chromosomes, and genes in language accessible to the general reader, then explains the levels of resolution at which genetic and physical maps can be constructed, technologies for determining the base sequence in a DNA fragment, and the model organisms employed.

"Where the HGP is Carried Out" surveys the research and resource centers, as well as the forms of corporate involvement. The *Guide*'s final chapters describe the publications that focus on genome studies, including electronic means of sharing information, and then addresses the ethical, legal, and social implications arising when we each know our own genetic makeup—and others possibly know it also.

Helpful appendixes present key personnel, genetic diseases, bibliography, glossary, acronyms (and their expanded forms!) and a genome project timeline. George W. Beadle and Edward L. Tatum begin the chronology with their "one gene, one enzyme" hypothesis, articulated in 1940–41. The genetic code was completely deciphered in 1965; the first human gene mapping workshop convened in 1973; Frederick Sanger, Allan M. Maxam, and Walter Gilbert developed DNA sequencing techniques in 1975–77; Applied Biosystems and Du Pont marketed the first automated sequencer in 1987; and the following year the Human Genome Project was funded.

The 40-page *Guide to the Human Genome Project* is available from the Chemical Heritage Foundation, at $10 per copy by check or money order for North American orders; $5 additional per order overseas.

BIMOSI Conference—

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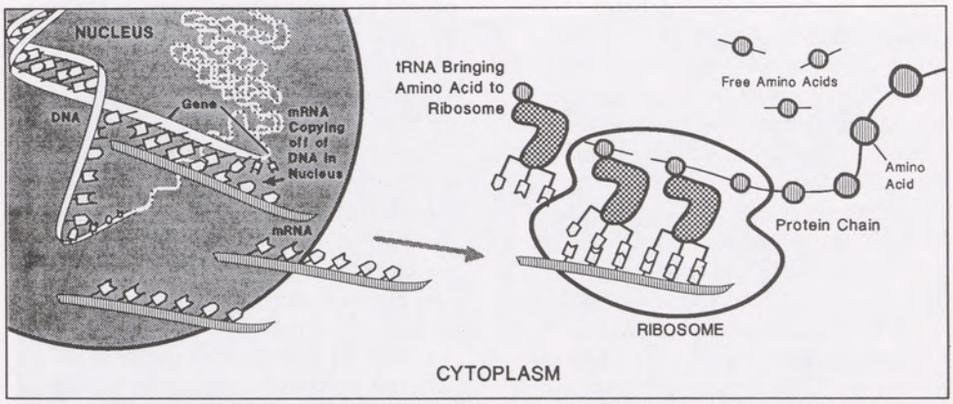
Creager (Harvard), Michael Fortun and Lily Kay (MIT), Tom Gieryn (Indiana), Susan Wright (Michigan), and many other young scholars at work on the emerging heritage of this major revolution of our day. The noted genomics scientist Norton Zinder of Rockefeller University is to give an after-dinner talk and provide an insider's perspective on issues discussed at the conference.

A full report will appear in *Chemical Heritage* 11:2.



In the first step of gene expression, messenger RNA (mRNA) is synthesized, or transcribed, from genes by a process somewhat similar to DNA replication. In higher organisms, this process takes place in the nucleus of a cell. In response to certain signals (e.g., association with a particular protein), sequences of DNA adjacent to, or sometimes within, genes control the synthesis of mRNA. Protein synthesis, or translation, is the second major step in gene expression. Messenger RNA molecules are known as such because they carry messages specific to each of the 20 different amino acids that make up proteins. Once synthesized, mRNAs leave the nucleus of the cell and go to another cellular compartment, the cytoplasm, where their messages are translated into the chains of amino acids that make up proteins. A single amino acid is coded by a sequence of three nucleotides in the mRNA, called a codon. The main component of the translation machinery is the ribosome—a structure composed of proteins and another class of RNAs, ribosomal RNAs. The ribosome reads the genetic code of the mRNA, while a third kind of RNA molecule, transfer RNA (tRNA), mediates protein synthesis by bringing amino acids to the ribosome for attachment to the growing amino acid chain. Transfer RNAs have three nucleotide bases that are complementary to the codons in the mRNA.

Gene expression. From Office of Technology Assessment, Mapping Our Genes: Genome Projects—How Big, How Fast? *(Washington, D.C.: USGPO, 1988), p. 23.*

Staudinger, Polymers, and Political Struggles

Hermann Staudinger (1881–1965), the German chemist and 1953 Nobel laureate, initiated his epoch-making study of polymers during World War I; it culminated during the Weimar and Nazi periods. This context might well lead one to wonder whether there was any connection between Germany's political upheaval and Staudinger's research activities—a question that has not received attention until recently. Staudinger's well-known autobiography, *Arbeitserinnerungen* (1961), makes no mention of it, and neither his students nor his contemporaries chose to disclose this somewhat sensitive aspect of his life.

In the late 1970s Staudinger's widow, Magda Staudinger, donated a large collection of his letters, documents, and unpublished papers to the Deutsches Museum in Munich. In 1983 a Freiburg historian, Hugo Ott, discovered a number of startling confidential documents from the Nazi regime (see his *Martin Heidegger: Unterwegs zu seiner Biographie*, 1988). These materials, together with my interviews with Magda Staudinger and other sources, provide a new insight into Staudinger's scientific life, his antiwar campaign during World War I, and his subsequent political struggles in German academic circles up to the 1940s. My aim is to examine how political tensions affected the course of his scientific activities and particularly the German macromolecular debate.

Hermann Staudinger was born in 1881 in Worms, Germany. His father, Franz Staudinger, was a neo-Kantian and Marxist philosopher and a leading thinker in the German Social Democratic Party. The father's ideology no doubt shaped the son's pacifist outlook. In 1906, a year before his appointment at the Technische Hochschule in Karlsruhe, Hermann Staudinger married Dorothea Förster, an active socialist.

When the First World War broke out in summer 1914, Staudinger was professor of chemistry at the Technische Hochschule in Zurich. Switzerland—politically tolerant—harbored many pacifists and socialists to whom his antiwar sentiments were congenial. He and Dorothea joined a pacifist circle organized by Leonhard Ragaz, an evangelical socialist at the University of Zurich. There are also indications that Staudinger was in contact with Georg Friedrich Nicolai, the German pacifist known for his book *Die Biologie des Krieges* (1917).

In 1917, shortly after the United States entered the war, Staudinger made several public statements that implicitly criticized his country for continuing to pursue this desperate, technology-based war. He pointed out that the Central Powers were inferior to the U.S. in industrial resources such as coal and iron. With the hope of encouraging peace negotiations, he wrote Erich Ludendorff, the head of the German military, setting out his opinion. The reply Staudinger received disregarded his concerns and instead informed him of Germany's plan to gain victory by widespread use of poison gas at the front.

Staudinger feared expansion of chemical warfare, which had started in 1915. He immediately asked the International Committee of the Red Cross in Geneva to appeal to the warring powers to stop using poison gas. In response the Red Cross wired such an appeal in February 1918 to the governments of the Allies and the Central Powers as well as to the pope. (Much of the inside story may be found in the diary of Romain Rolland, a French novelist living at the time in Switzerland and active in the antiwar movement.) Staudinger then sent a manuscript denouncing chemical warfare to the International Red Cross. It was translated into French and appeared in *Revue internationale de la Croix-Rouge* in mid May 1919, shortly after the Allies had ratified the provisions of the Versailles Treaty. (Germany was to sign the treaty in early June.)

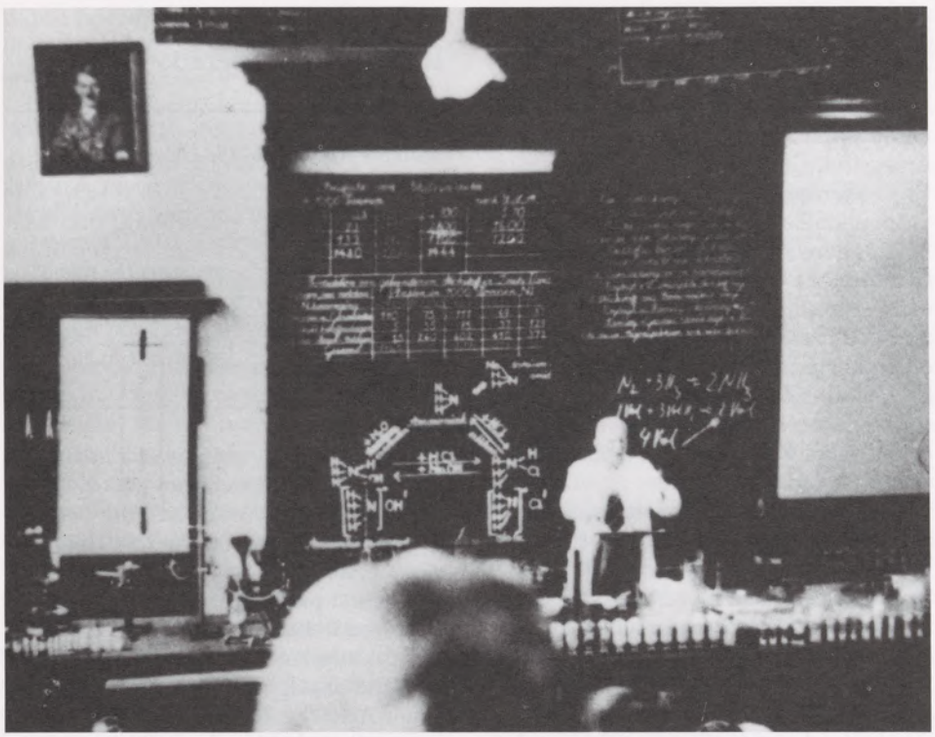
In the fall of 1919 Staudinger sent a reprint of this article to a former colleague at Karlsruhe, Fritz Haber, who had played a crucial role in German research on and development of poison gas. Haber's reply was bitter: "What bothers me is that you do not realize the effect of your French paper at all. . . . You betrayed Germany at the time of her greatest crisis and helplessness." Haber believed that Germany's use of poison gas did not violate international law, and that it was the French, not the Germans, who first used poison gas, despite the Allied claim. To enforce its "Punic peace," he continued, the enemy needed "punishable dirty tricks" (*strafbare Gemeinheiten*) to justify its vindictiveness. Haber insisted that

Hermann Staudinger with his son, Hansjürgen, around 1920. Courtesy Deutsches Museum, Munich.

Staudinger's article helped support the enemy's demands and thus caused irreparable damage to the Reich. In conclusion, Haber declared an end to his friendship with Staudinger (Staudinger Papers, Deutsches Museum).

Staudinger found Haber's accusations intolerable. A month later he wrote him that the Red Cross paper had been intended to bring public attention to the ominous nature of modern technology. Technology changed the structure of modern warfare, and its abuse could destroy the world. He added, "I only want to express my astonishment that you, the man who in essential ways contributed to this change in the world situation with your ammonia synthesis and the resulting possibility of endless explosives production, do not understand the fundamental significance of this change" (Staudinger Papers). As this exchange reveals, Staudinger's remarks in time of war incurred Haber's anger, and the attitude of this influential German scientist was in turn to affect Staudinger's postwar career.

In the early 1920s Staudinger published a series of papers on his new theory that polymers were macromolecules. The theory soon provoked attacks from supporters of the aggregate theory,



Staudinger lecturing in Freiburg in the late 1930s. Courtesy Deutsches Museum.

which held that polymers were aggregates of small molecules. As he devoted himself to defending and demonstrating his macromolecular theory, Staudinger apparently forgot his earlier political concerns.

In 1925 the University of Freiburg offered Staudinger a position as successor to the organic chemist Heinrich Wieland, on the condition that he explain his "political past." The Freiburg faculty had no doubt learned about that past from Haber. As he wanted to return to the German scientific community, Staudinger went to Freiburg and made his excuses, now stating that gas weapons might not be too inhumane, and that he had not considered their use criminal. This apology satisfied Wieland and the Freiburg faculty. Staudinger divorced Dorothea, left his three children in Zurich, and moved to Freiburg in 1926 to take over this distinguished professorship.

Several months later the Society of German Scientists and Physicians arranged for a symposium on polymers at its annual meeting in Düsseldorf. Haber helped organize the symposium, which would become famous for its historic debate, from behind the scenes. He pitted leading advocates of the aggregate theory, including Max Bergmann and Hans Pringsheim, against Staudinger. Although polymers were not Haber's own research specialty, it was no accident that he took an unusual interest in the macromolecular debate—and was in favor of the aggregate theory at this stage. Staudinger found himself isolated in the face of criticism, and the symposium ended with no agreement on the issue of macromolecules.

When Hitler came to power in 1933, Staudinger's "political past" became a Nazi target. That year the noted philosopher Martin Heidegger became rector of the University of Freiburg. Heidegger secretly reported to the Gestapo on Staudinger's wartime activities and sought his resignation. The Gestapo began investigation. Under pressure, Staudinger considered seeking refuge in the United States, as had his younger brother Hans. Hans, a former social-democratic representative of the Reichstag (the national parliament in Berlin), had fled with his Jewish wife to America in 1934. He later became professor of economics at the New School for Social Research in New York. After due consideration, however, Hermann Staudinger chose to stay in Freiburg to continue his polymer research, which was reaching an exciting stage. He had been putting a large amount of his own money into his laboratory and had just found able young collaborators.

While those of Staudinger's chemical disputants who were Jewish left Germany—including Haber, Bergmann, Pringsheim, Reginald O. Herzog, Hermann Mark, and Kurt H. Meyer (some of whom later changed their minds about his theory)—other formidable antagonists managed to take influential positions under the Nazi regime. Among them was Kurt Hess, a cellulose chemist who continued to oppose

Continued on next page

In November 1933 the rectors of Germany's leading universities met in Leipzig in support of the Nazi regime. The philosopher Martin Heidegger (with black mustache), rector of Freiburg University, is seated seventh from the left. From Illustrierte Zeitung, *23 Nov. 1933.*

STAUDINGER—*continued*

Staudinger's theory. At the time he worked at the Kaiser Wilhelm Institute for Chemistry, and in the 1930s he was an important member of the Nazi Storm Troopers (SA), with close connections with the Berlin government. A rumor that Hess was trying to discharge Staudinger and even to replace him at the university caused Staudinger much agony. Perhaps the rumor was not groundless; Hess had long cherished a desire to be a university professor, especially at Freiburg, where he took his *Habilitation*. In the event, Hess remained extraordinary professor at the University of Berlin. Another opponent was Wolfgang Ostwald, who, as Staudinger noted, embarked on open criticism of Staudinger's work on polymers only after he became an arbitrator of Nazi academic affairs. This timing and the unreasonable and far from scientific nature of Ostwald's criticism aroused Staudinger's distrust of this leading colloid chemist.

Staudinger experienced many difficulties. He was no longer invited as lecturer by major scientific societies in Germany, such as the Society of German Scientists and Physicians, the German Chemical Society, and the Society of German Chemists; nor was he allowed to attend international meetings after 1937, something other scholars were still allowed to do. His research funds were cut, his publications blocked, and his assistants, such as Werner Kern and Günther V. Schulz, found it extremely difficult to obtain academic positions. These problems, he realized, resulted largely from the actions of his Nazi academic opponents. Staudinger thus believed that German polymer chemistry was victimized by Nazism.

Some of Germany's industrial leaders, however, recognized the industrial significance of Staudinger's work from its early stages and tried to incorporate it into their research on and development of synthetic rubber and plastics. In all likelihood, they helped him escape dismissal or arrest. Possible candidates include Georg Kränzlein and Erich Konrad of IG Farben.

Staudinger made no overt political commitments during the Nazi regime. Whatever the rhetoric, it is unlikely that the difficulties he encountered in his scientific activities were based solely on his "political past" during World War I. Some of his scientific opponents were in a position to use their political power to attack Staudinger's chemical ideas and professional activities. Thus the macromolecular debate not only exhibits theoretical conflict and disputes over priority, but also reflects political tensions of the time.

YASU FURUKAWA
CHF and Tokyo Denki University

A more extensive study is available in Yasu Furukawa, "Staudinger's Scientific Activities and Political Struggles" (in Japanese), *Kagakushi* (Journal of the Japanese Society for the History of Chemistry), 20 (1993), 1–19.

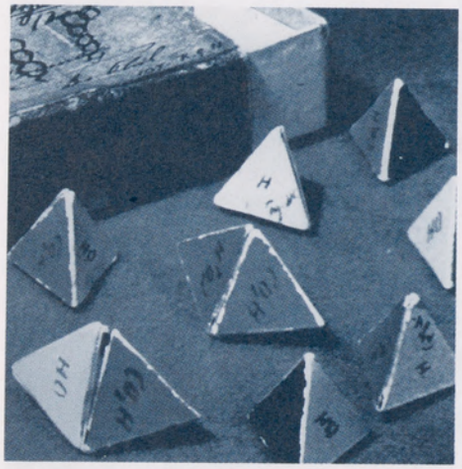
The American Research University

*Theodore L. Brown, founding director of the Beckman Institute of the University of Illinois in Urbana, spoke at the Bower Award symposium last year honoring Arnold Beckman (*Chemical Heritage *10:2, Summer 1993, p. 4). Brown's topic was the role of the American research university in a technological society, and his historical introduction will be of particular interest to our readers.*

The research university is a relatively recent phenomenon in the history of the nation. The first American Ph.D. degrees were awarded from Yale University, beginning in 1861.

The first public institutions with broadened charters that included research came into existence in the 1860s with the passage of the Morrill Land Grant Act. The institutions founded pursuant to this legislation were assigned an outreach function. They were to provide service not just to students, but outside the campus—to the people of the state and the nation.

The tradition of research and scholarship that has pervaded the American research university has its origins in the German university. . . . The Johns Hopkins University, begun in the 1870s, was modeled after the German university. . . . The newly emerging public universities also sought to recruit scholars with research backgrounds. . . . In these



J. H. van't Hoff's three-dimensional paper models of carbon-containing compounds, now in the Leiden Museum. Courtesy O. Bertrand Ramsey.

Is Carbon Tetrahedral?

The devil theory of history is certainly convenient but seldom is the story starkly black and white. Hermann Kolbe was not alone in questioning the tetrahedral carbon theory, nor were his doubts purely reactionary. Peter J. Ramberg examines the early years of stereochemistry in his newly completed doctoral thesis for Indiana University, "The Early History of Stereochemistry, 1875–1920: Physical Models of the Atom for Chemical Theory."

In 1874 Jacobus Henricus van't Hoff asserted the need to go beyond the structural theory of Archibald Couper and August Kekulé, which had merely established the connectivity of atoms—the sequence of atoms linked to each other irrespective of location in space. In order to account for many puzzling cases of isomerism, van't Hoff asserted that atomic structure is geometric—that the bonds from atoms radiate in definite directions. He moved organic chemistry from "rubber sheet geometry," or topology, to three-dimensional Euclidean geometry. Three years later Johannes Wislicenus revitalized many of van't Hoff's ideas and worked out a new approach to chemical problems that included a molecular dynamics, an early view of reaction mechanisms. Victor Meyer, Karl von Auwers, and Arthur Hantsch developed the new concepts further, but a principal and persistent opponent of the new stereochemical ideas was Arthur Michael of Tufts College in Boston.

public institutions there arose the idea of a threefold mission of teaching, research, and public service. . . .

In the twentieth century, particularly in the period between the two world wars, the public institutions built the growth of research activities through expanded enrollments. There was some, but not a great deal, of industrial money spent in support of academic research. The prevailing ethic was that academic research should be undirected, driven only by purely intellectual considerations; the benefits of such research to the society, though unforeseeable at the time, would eventually materialize. At the same time, there were connections between industrial research and academe through consulting activities on the part of faculty members, and in the placement of Ph.D.-level graduates.

World War II was a watershed period for academic research. The major research institutions played important roles in the development of technologies for the war effort; examples are the Manhattan Project and the development of radar and other electronic technologies at the Radiation Lab at MIT.

Though the federal agencies were formally mission-oriented, much of the postwar research support provided by the Atomic Energy Commission and the Office of Naval Research went for broadly based and largely undirected work. The major theme had become the development of scientific and engineering human capital. . . .

All of these developments were based on a fundamental policy decision made after the war and expressed in the establishment of the National Science Foundation: The nation's basic, long-range research effort was to be centered largely in the universities, not in American equivalents of Max Planck Institutes, nor extensions of the National Bureau of Standards, nor in private nonteaching institutes such as Battelle or the Carnegie Institution.

This is an important point. The policy meant that the *levels* of research support in universities, the *areas* to be supported, and many other factors that would determine the *shape* and *size* of the academic research enterprise would themselves be determined to a large extent by factors extrinsic to the universities. This became clear when the Soviets launched Sputnik and a major transformation of the university research system ensued. The emphasis was heavily on basic science: on the development of human capital that would be prepared to carry out research and development in industry and in governmental laboratories. During the period 1953 to 1968 total university research and development grew more than three times faster than the GNP, and the basic university research part grew substantially as a fraction of the whole, outpacing the GNP during that period by a factor of about six.

As a consequence of the enormous influx of federal funds for support of academic science and engineering, physical facilities, faculty salaries, instrumentation, graduate student support—all these and more—became dependent on acquiring federal grant support. Institutions added new faculty, expanded existing departments, and added new departments in response to the signals from the federal government as to which areas were to receive increased research funding. Increasingly, faculty members saw the amounts and kinds of support received from federal granting agencies, and evaluations by their peers in the review system, as primary yardsticks of their success as academics.

THEODORE L. BROWN

IONIC POLYMERS

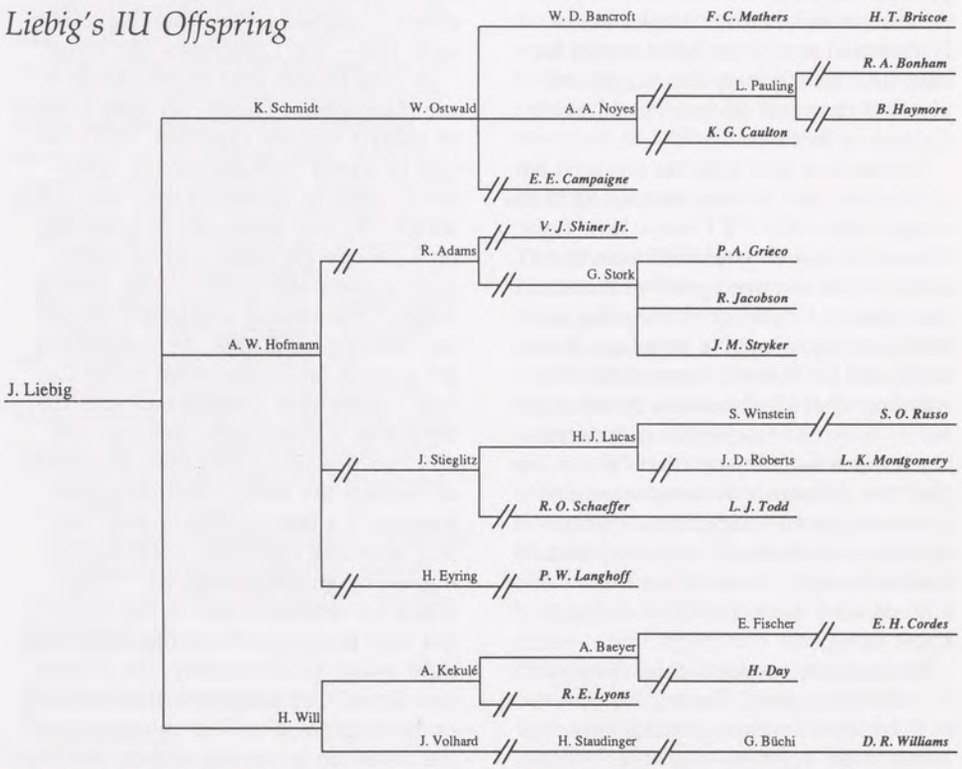
Continued from page 2

they did—ionic conducting polymers had arrived.

In retrospect ours was a sort of particle collision—the coming together of two different backgrounds leading to an interaction that sparked off a new direction of research. Peter then went on to work seriously in this area, and I moved on to explore new types of macrocycles and their application in metal ion recognition and bioinorganic chemistry. I don't think that either of us would have anticipated the eventual impact that this brief interaction would have.

DAVID E. FENTON
University of Sheffield

Liebig's IU Offspring

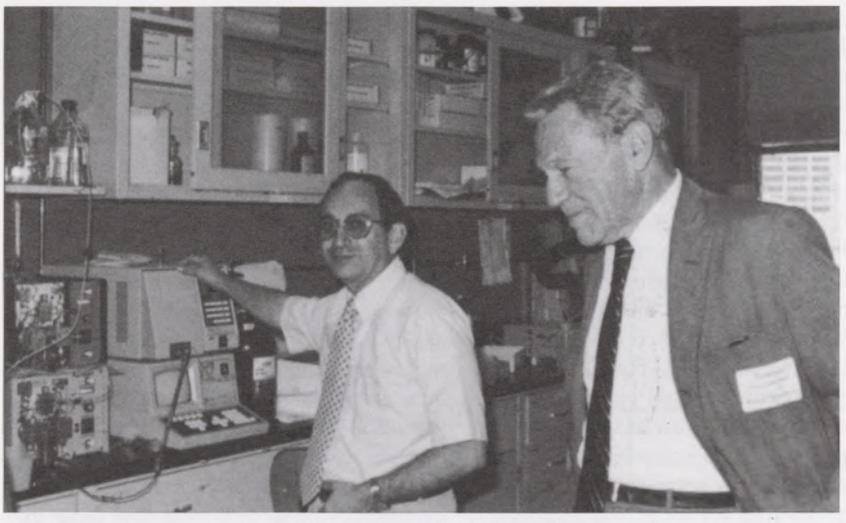


In answer to our inquiry about Liebig descendants among our readers, Ernest E. Campaigne of Indiana University has shared with us his researches concerning the chemical origins of IU faculty. He discovered nineteen present and former IU chemists (shown in ***boldface****) who are linked to Liebig as shown. He would be happy to supply additional information, including the names of intermediate mentors not shown in the table but indicated by double diagonals: //.*

On File: Oral Histories

Norman Hackerman: "Behind the Curve" Part II

Part I, which appeared in issue 10:2 (Summer 1993), told of Norman Hackerman's decision to go into chemistry and of his quasi-picaresque journey through several more problematic branches of the subject before he settled on his dissertation topic.



Norman Hackerman (right) with Louis Hersh of the University of Texas Southwestern Medical Center. Courtesy the Welch Foundation.

Making Ends Meet

There still were no jobs when Hackerman got his degree in 1935. He applied for an instructorship at Ohio State, but he and O. K. Rice, already a faculty member, were just two of one thousand applicants, and neither was successful. Joseph E. Mayer was looking for a way "to make enough money to stay viable during the Depression," and took a position teaching freshmen at Hopkins. "He was a very bright guy," Hackerman remembers. "Quantum mechanics he knew. But he didn't know any freshman chemistry. He didn't know about precipitating iron sulfide or how you determine chromium." Mayer asked Hackerman to run the laboratories for him, and Hackerman also taught the physical chemical laboratory at Loyola College in Baltimore.

Hackerman also kept his research lab at Hopkins and became interested in the oxygen electrode. "If I knew how I got interested in it, I would tell you, but I don't. But it annoyed me that it was irreversible. I decided I was going to find out why. Now it's fifty-four years later, and I still don't know why." It was here that Hackerman's future reputation as an electrochemist originated. He is quick to point out that "if you neglect the difference in temperature between my room-temperature system and the one-thousand-degree system of fuel cells today, I was doing the same kind of work back in 1936 and didn't know it!"

Hackerman also took consulting work to make ends meet. During his tenure in Patrick's laboratory, Patrick was asked to do a particle-size distribution on a clay thought to be bentonite. Since his silica gel patents made him financially secure, Patrick suggested that Hackerman do it. Hackerman measured the settling distribution curve within a few hours. He thought he would ask for $25, but Patrick said, "No. If you do that, they're going to think it's not worth anything because you're not charging them very much. Charge them $200." Following Patrick's suggestion, Hackerman sent the results—and the larger bill. "They wrote back, thanked me for the information, and sent the check. I learned a very valuable lesson from that—don't underrate the value!"

In 1936 Patrick sent Harry Hardy to see Hackerman. Hardy, an early version of today's venture capitalist, had a device in which "suspensions or emulsions could be produced that were fairly stable. He was interested in using this on a commercial scale, but he didn't quite understand what he was talking about." Hackerman suggested producing homogenized milk; he was offered $35 a week and some stock in the Colloid Corporation. Hackerman split the offer with a friend who was married and had one child, and they proceeded to develop the basic "electromagnetic hammer," a heavy piece of steel that was vertically oscillated 3,600 times a minute by an electromagnet. "There was a horrendous noise in the room," but they made good homogenized milk right away. Unfortunately, the Submarine Signal Company was also working on homogenized milk at the time, and they used an acoustical system that was much easier to operate. Thus Hackerman's 1936 system was never commercialized, and homogenized milk first appeared in 1937.

Other ventures of the Colloid Corporation met a similar fate. Tackling the problem of the separation of salad dressings, Hackerman suggested using carbon black as an emulsifying agent. It produced a very stable oil and vinegar emulsion, but "when Hardy took it home to his wife, she said she wouldn't use a black salad dressing! I tried to point out that carbon black would probably do the digestive processes some good, but we lost that one too."

Hackerman also looked at the problem of bismuth subsalicylate, which was used to treat syphilis. The needle-like crystals caused "terrible pain" when they were injected into a patient. "We broke that stuff up pretty good, and had it developed. The people at the Hopkins hospital were very interested because it certainly diminished the pain problem. But then they developed a better way of treating syphilis. So we were behind the curve all the way and finally folded" the Colloid Corporation in 1939. Hackerman held the stock for ten years, then took the loss off his income tax.

A Job at Last

As he continued his part-time activities in the late 1930s, Hackerman continued looking for a permanent position. He was turned down over four hundred times, even by the University of Witwatersrand in South Africa. He tried "camping out at the Department of Agriculture" in Washington, D.C., hoping to land a position in one of their four regional laboratories. While he "struck out" there also, he learned of testing

procedures to get on a job list for government jobs at a P1 or P2 (professional grade) classification. Some of his friends from Hopkins had been successful in getting a P1 offer—to become shrimp inspectors in Biloxi, Mississippi!

In 1939 Hackerman was offered a P1 job by the U.S. Coast Guard on Staten Island. The Coast Guard had just taken over the Federal Lighthouse Service at St. George, and right alongside the Staten Island ferry slip was a two-story building with the chemistry laboratory "cunningly hidden" on the top floor. The Coast Guard had never had a laboratory before, and Hackerman's assignment was to do analyses "as needed," mostly on brass, hemp, and paint. He rejected one paint shipment because it did not meet specifications. It was sent to the Coast Guard offices in Brooklyn, and "the company looked surprised. They took the shipment back, and about three days later brought in another one." Hackerman found it was the same shipment! All they had done was move it off the site and then return it. When this shipment was also rejected, "the captain and some irate guy from the paint company came over to see us. The irate guy became un-irate when he saw we had a laboratory, because he didn't know we had a laboratory testing this stuff." The next sample was "a good one," because "apparently it's three times and out, and you have to pay triple damages."

"His wife . . . said she wouldn't use a black salad dressing!"

From these rather inauspicious beginnings, Norman Hackerman proceeded to a distinguished career in electrochemical research and teaching, as a university and foundation administrator and as a statesman of science. He credits two elementary school teachers as being "instrumental in providing what I consider to be the important process in education, namely self-learning. Teachers are fine and they do help to guide and they kind of explain a few things. But back then, I got an instinctive feel for that fact that if you're going to learn, you have to do it yourself."

JAMES J. BOHNING

GRANTS

Edelstein International Fellowship

Applications are invited from established scholars for the 1994–95 Edelstein International Fellowship in the History of the Chemical Sciences and Technology. The Edelstein Fellow will be expected to divide his or her time between residency at the Chemical Heritage Foundation (CHF) in Philadelphia and the Edelstein Center for History and Philosophy of Science, Technology, and Medicine in Jerusalem. The resources of the Edelstein Library (especially strong in all aspects of chemical history) will be available to the holder in Jerusalem. Philadelphia resources include the Othmer Library of Chemical History and the Edgar Fahs Smith Collection. The major portion of the fellow's time will be devoted to research, but the fellow will also contribute to the work of each institution in an appropriate manner. The fellowship period is 1 September 1994 to 30 June 1995; it may be held in conjunction with other research or sabbatical support. A travel allowance is also available.

Letters of application should indicate how CHF and Edelstein Collection resources in the chemical sciences are relevant to the applicant's research; applicants should also enclose a financial statement, a curriculum vitae, and the names of three references. Applications should be received by 15 November 1993 and should be sent to Professor Seymour Mauskopf, Coordinator, Edelstein International Awards, Department of History, Duke University, Durham, NC 27708; phone (919) 684-2581.

Owen Hannaway, professor of the history of science at the Johns Hopkins University, was chosen Edelstein International Fellow for 1993–94, but illness prevented his coming.

The 1990–91 Edelstein Fellow, William H. Brock, returned to the Foundation this September for another two months of research.

Edelstein International Studentship

The Edelstein International Studentship is available to support dissertation research and writing in the history of the chemical sciences and technologies. Candidates should have fulfilled all requirements for the Ph.D. except the dissertation. The Studentship provides a stipend and travel and dissertation fee support for a five- to six-month residency in Philadelphia at the University of Pennsylvania and a three- to four-month stay at the Hebrew University of Jerusalem in the course of the academic year. Resources in Jerusalem and Philadelphia are as noted for the Edelstein Fellowship. Candidates for the 1994–95 Studentship should send applications to Professor Seymour Mauskopf at the address given in the Fellowship announcement, by 15 November 1993. Applications should include a dissertation prospectus, a brief statement of research and writing plans for the year of the Studentship, a curriculum vitae, and the names and telephone numbers of two references.

The first Edelstein International Student (1992–93) was Kathleen Steen of the University of Delaware. Her dissertation focused on the development of the synthetic organic chemicals industry in the United States, 1910 to 1933. (See *Chemical Heritage* 10:2, Summer 1993, p. 6). The new Edelstein International Student is James Altena, a graduate student at the University of Chicago. He is working on his dissertation, "Science, Philosophy, and Social Reform in Imperial Germany," which focuses on the energism of Wilhelm Ostwald.

Travel Grants

The Chemical Heritage Foundation offers small travel grants to enable interested individuals to make use of the research resources of the Beckman Center for the History of Chemistry, the Othmer Library of Chemical History, and associated facilities.

Grants, which may be used for travel, subsistence, and copying costs, will not normally exceed $500. Applications should include a vita, a one-paragraph statement on the research proposed, a budget, and the addresses and telephone numbers of two references. Deadlines are 1 February for grants to be used April–June; 1 May for July–September; 1 August for October–December; and 1 November for January–March. Applications should be sent to Dr. Lawrence B. Friedman, Associate Director, Chemical Heritage Foundation, 3401 Walnut Street, Suite 460B, Philadelphia, PA 19104-6228.

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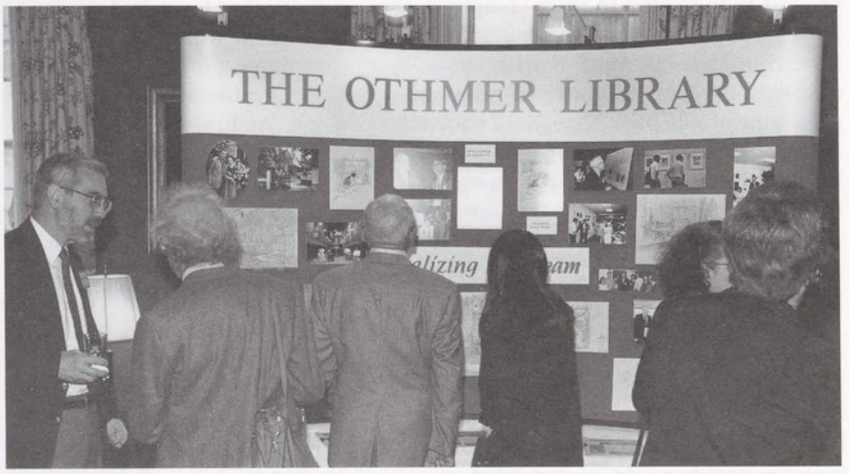
NEWS from the Donald F. & Mildred Topp Othmer Library of Chemical History



Left: Donald Othmer, the center of attention, is here greeted by Ralph Landau (center) and Matthew Rizai of Chicago (standing), among others. Right: The assembled guests view the progress of and plans for the Othmer Library.

The 1993 Othmer Luncheon: The Power of Ideas—and of a Dream

ON A DATE NEAR Don Othmer's eighty-ninth birthday, 150 members and friends of the various associations of the chemical community gathered at the Princeton Club in New York for the Othmer Luncheon.

The weather in New York the previous day had been old and wet, but by the time of the luncheon the city seemed to smile on the proceedings. It was a perfect day, sunny and pleasantly warm, mirroring the upbeat mood of Don Othmer and well suited to the pictorial display of future building plans—entitled "Realizing the Dream"—for the Othmer Library of Chemical History. Traffic on the Brooklyn Bridge delayed Don's arrival, but characteristically this observant engineer, as he told the company, used the opportunity to study those details of design and construction of that hundred-year-old marvel more intently than he had ever been able to in a quick passage.

Thus Dr. Othmer at eighty-nine greets every new hurdle and challenge. His response epitomizes his eminently practical personality, as the many friends who came to honor him at the Othmer luncheon can attest. Five groups now sponsor the event: CHF; its founding societies—the American Chemical Society and the American Institute of Chemical Engineers—and two associated societies—The Chemists' Club and the Société de Chimie Industrielle. All have deep ties with each other and with Don Othmer.

The master of ceremonies, Edwin J. Bassler, president of AIChE, opened the proceedings by noting that although five speakers were scheduled in less than an hour, they were all chemical engineers with a tradition of being concise and to the point, and thus all would be well. Next John C. Haas of Rohm and Haas placed the rapidly developing Othmer Library of Chemical History in the lineage of great libraries, a lineage that began with Alexander the Great's library in Alexandria, Egypt, and runs through the Bodleian at Oxford, the Widener at Harvard, the Library of Congress, and such wonderful specialized collections of the twentieth century as the Folger Shakespeare Library in Washington, D.C., and the Huntington Library in Pasadena, California.

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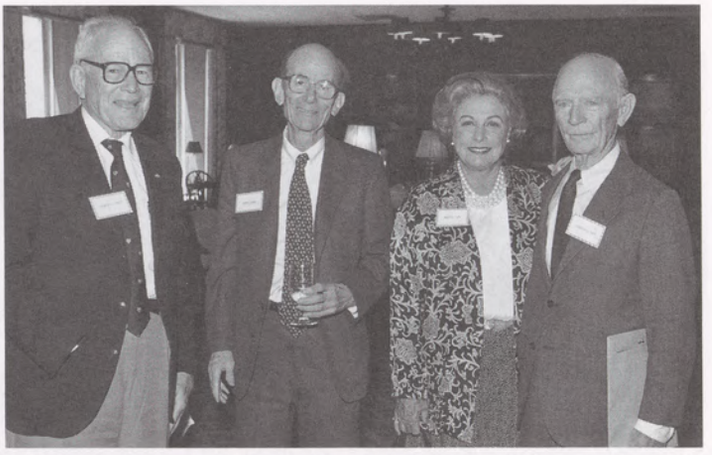


Charles C. Price and John C. Haas greet Gordon Cain, speaker at the Othmer luncheon, and his wife, Mary H. Cain.

OTHMER LUNCHEON—

continued

Donald Othmer welcomed the five sponsoring societies, in all of which he has played leading roles. He pointed to their interconnections and the common ground they shared in their chemical heritage. Yet some of their practices have changed. He recalled with some nostalgia the late 1940s, when he was president of AIChE's New York section. It then gathered for dinner meetings, but dropped them "since it was easier to get lunch time off from the boss than dinner time off from the spouse." He also recalled that in his first radio lecture in 1935 he reported that scientists were predicting that in forty thousand years Great Britain would be under the ocean. Yet, as an engineer with years of work on heat transfer problems, he questioned the confidence with which some scientists could now predict exactly how far the ocean will rise, should a possible one-degree warming of the globe per century cause the polar ice to melt.

Ralph Landau of Listowell Incorporated introduced the guest speaker, Gordon A. Cain. (Landau himself is the Ralph Connor lecturer as CHF and the University of Pennsylvania celebrates the centennial of Penn's department of chemical engineering in October; see p. 25.) An entrepreneur who pioneered the acquiring and refashioning of chemical companies, Cain now heads Sterling Chemicals and Atlantic Coast Airlines. He also was an early proponent of making employees co-owners of companies.

Cain began his thoughtful address, "Science and the Economy," by recalling that Don Othmer interviewed him for admission to a course at Brooklyn Poly. Cain worked for Merck at Rahway at the time and was a member of ROTC; he never took the course, because he was called to active service.

The speaker shared with his audience some salient and simple ideas in economics that have had a salutary effect on human well-being. The first was the questioning of the divine right of rulers to determine and control economic decisions. As long as they were in absolute control, there was no progress; but the ideas of John Locke and Thomas Jefferson, and especially of Adam Smith in *The Wealth of Nations* (1776), shifted the emphasis to individual initiative and the individual's ability to energize and control the marketplace. The result of this revolution in ideas has been a twenty-fold increase in our living standards—"less of our effort goes into making a living and more into improving the way we live."

Another idea involved landholding. Agricultural production in 1750 required 90 percent of the population. In 1850 the figure had dropped to 50 percent, and today in industrial countries it is down to less than 3 percent. Here the major change occurred when the enclosure movement led to economies of scale as smaller plots were combined.

The great innovative ideas in modern industry were the concept of intellectual property—embodied in patents, which bring new ideas to public use—and the concept of the limited-liability company, which by taming risk made feasible large-scale entrepreneurial activity.

In closing, Gordon Cain challenged us all to reflect on the power of certain clear and simple ideas to shape the world.

A galaxy of presidents of the Société de Chimie Industrielle—former and current—pose for the camera at the Othmer Luncheon. James W. L. Monkman, Abe O. Zoss, Paul F. Copp (current president), Donald F. Othmer, Ernest R. Gilmont, and Patrick P. McCurdy.

Gifts Keep on Coming

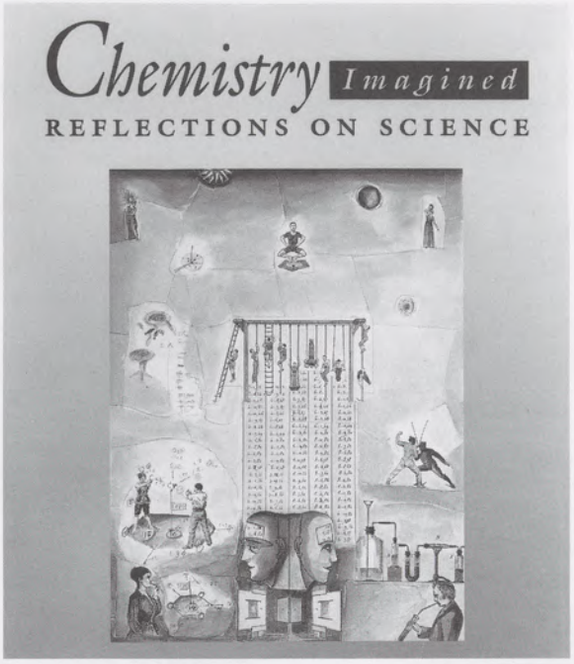
■ Among the many welcome gifts to the Othmer library was a collection of over eight hundred books from those **Marcel Dekker** accumulated when he, Eric Proskauer, and Arnold Weissberger headed Interscience Publishers, later a division of John Wiley and Sons. Interscience published major series and compilations such as Weissberger's *Techniques of Organic Chemistry* and the *Kirk-Othmer Encyclopedia of Chemical Technology*. Three quarters of the books are Interscience imprints, many of them in mint condition; the rest are from Dekker's personal library. The books are a gift from Dekker's son, Marcel Dekker, current president of the publishing concern Marcel Dekker, Inc.

■ **Joan W. Bennett** of Tulane University, New Orleans, recently sent us an autographed copy of *Takamine: Documents from the Dawn of Industrial Biotechnology* (Miles Inc., 1988), which she edited. The book's superb craftsmanship is a worthy tribute to Jokichi Takamine, to whom we owe the Japanese cherry trees at the Jefferson Memorial in Washington, D.C. Takamine worked on diastase (amylase), isolated epinephrine, and developed both into commercial products. Donald F. Othmer is mentioned in the book as one of those who supplied essential information for the editor. Miles Inc. bought Takamine Laboratories in 1956.

■ **John F. Baxter** of the University of Florida capped a distinguished chemical career by becoming a television personality during the 1960s. He headed the cast of "Understanding Chemistry," the chemical component of "Continental Classroom." His widow, Bonnie E. Baxter, of Gainesville, Florida, sent us 159 original reels of film and associated papers that document this pioneering contribution to the public understanding of chemistry.

■ The **Filmfabrik Wolfen AG** of Wolfen, Germany, sent us five segments of its series on the history of the company. These cover the company's development and production of chemical fibers, the transition from photographic plate to film, and the history of the company as a whole from 1919 to 1925.

PUBLICATIONS



Mood Mauve, Magenta, Alizarin, . . .

Anthony S. Travis. *The Rainbow Makers: The Origins of the Synthetic Dyestuffs Industry in Western Europe.* Bethlehem, Pa.: Lehigh University Press, 1993. 335 pp. $49.50.

It is still hard to associate sticky black tar with the colors of the rainbow—magnificent colors embodied in chemical substances that permanently dye fabric and cloth. Hard to believe that discoveries made on industry or university lab benches could put thousands out of work, employ thousands with other skills, and determine the economic supremacy of one nation over another. That epic tale of human ingenuity, entrepreneurial risk-taking, and economic consequences is the substance of this book. Rather than a tedious listing of discoveries, networks of chemical structures, and outlines of company histories, the book concentrates on processes and the working environments of those involved. Thus the driving forces that led to innovations can be identified and the changeover from craft-based to science-and-industry-based innovation discerned. Mauve, magenta, alizarin, and indigo supply the titles to the four parts of the story—a detailed historical reinterpretation of the most remarkable science-based activity of the nineteenth century.

Chemistry ReImagined

Roald Hoffmann; Vivian Torrence. *Chemistry Imagined: Reflections on Science.* Washington, D.C: Smithsonian Institution Press, 1993. 168 pp. $19.95.

The origins of *Chemistry Imagined* were described in our pages in 1990 (Summer 1990, 7:2, p. 6), and the exhibit of that name was on view at CHF two years later (see *Chemical Heritage* 10:1, Winter 1992–93, p. 25). Now reincarnated as a book, *Chemistry Imagined* is a new experience again, allowing the reader to fathom the insights of Roald Hoffmann's commentaries at leisure, and Vivian Torrence's collages to reveal their many facets, speak their messages, and exhibit their interrelations.

The public knows the chemical community through chemicals. Of sulfuric acid, one of the chemical world's top ten hits, Hoffmann says,"More than 87 billion pounds of it were synthesized in 1991, and I assure you this quantity was not made for fun. It was made because someone out there was willing to pay for it." Chemical concepts, on the other hand, have their origins, echoes, and associations in fields as diverse as psychology, art, politics, and mathematics. Collage permits such linkages to be explored. Some of the titles: *Radium, Air of Revolution, Blood Counts, Formulation, Steps and Processes, The Grail.* Hoffmann's commentaries are at times chemical, at times autobiographical. Marie Curie reminds him of his Polish childhood, when he read of her and of George Washington Carver. "He rereads these books, and sees that they are hagiographies. The romance is off the radium. But Marie Curie still makes him cry."

As Hoffmann is a poet, an occasional poem slips in. A long one on Fritz Haber touches on poison gas, his synthesis of ammonia, his attempt to pay Germany's war debt with gold from the oceans, and Germany's rejection of him, a Jew. An excerpt:

over the dawn field at Ypres, he carefully
took notes, forgot his wife's sad letters.
After the War, Fritz Haber dreamed in Berlin
of mercury and sulfur, the alchemists' work

hastening the world, changing themselves.
He wondered how he could extract the
millions
of atoms of gold in every liter of water,
transmuting the sea to the stacked bullion

of the German war debt . . .

Much to think about, much to appreciate.

Two Books on the German Chemical Industry

Walter Wetzel. *Naturwissenschaften und Chemische Industrie in Deutschland: Voraussetzungen und Mechanismen ihres Aufstiegs im 19. Jahrhundert.* (Frankfurter Historische Abhandlungen, 32). Stuttgart: Franz Steiner Verlag, 1991. 338 pp. DM 128.00.

Walter Teltschik. *Geschichte der deutschen Grosschemie: Entwicklung und Einfluss in Staat und Gesellschaft.* Weinheim, Germany/New York: VCH, 1992. 426 pp. $40.00; DM 58.00.

The authors of these two books worked in industry, Walter Teltschik for more than thirty years. Walter Wetzel's scholarly study examines the relations of science, industry, and government that led to Germany's industrial supremacy before World War I. Teltschik's work, more popular in tone and more dependent on secondary sources, is a detailed and evenhanded social history of the German chemical industry. He not only celebrates its triumphs but analyzes its failures. He looks at industrial catastrophes and environmental pollution,

Continued on next page

PUBLICATIONS—*continued*

carefully examines the disastrous era of collaboration with the Nazi regime, and ends by describing the industry's modern resurgence in the framework of its commitment to social ideals.

Unriddled?

John H. Wotiz, editor. *The Kekulé Riddle: A Challenge for Chemists and Psychologists.* Clearwater, Fla. Cache River Press, 1993. 329 pp. $78.00.

In the town hall of Berlin in 1890, August Kekulé was honored on the twenty-fifth anniversary of his publication of the closed-chain formula for benzene. The centennial of that occasion was marked by a symposium at the ACS meeting in Boston that examined Kekulé's contributions and his debt to others.

Kekulé spoke poetically and at length about a vision of atoms holding hands and dancing in circles. Because he alluded to dozing and dreaming ("Let us learn to dream, gentlemen, then perhaps we shall find the truth; but let us beware of publishing our dreams before they have been put to the proof by the waking understanding"), some commentators, including psychologists, assume that he slept, which allowed the creative juices to flow. With Kekulé as prime example, theories of sleep-based creativity have been floated. But John Wotiz, the editor of this volume, believes that Kekulé concocted the dream stories, and Albert Rothenberg of Harvard Medical School, after consulting eminent translators, concludes that Kekulé never said that he slept, but instead that he daydreamed—and that it was in this state between waking and sleeping that he became aware of new associations and perspectives that led to his theories.

Nineteen symposium presentations by an international group, ranging from polemical to highly scholarly, now constitute this volume of explorations of Kekulé's life and of scientific creativity in general. John H. Brooke looks at the contributions of Auguste Laurent and other French chemists; Colin A. Russell at Edward Frankland; William H. Brock at Henry Armstrong; Vladimir I. Kuznetsov and Alexei Shamin at A. M. Butlerov; while Christian Noe and Alfred Bader present the case for Josef Loschmidt. A major candidate for credit for priority, Archibald Scott Couper, was as usual scarcely mentioned. Much new and valuable material on Kekulé and the chemistry of his time is included. The book's editor says that the Kekulé "riddle has now been solved." This reviewer, alas, is not yet convinced.—OTB

Other Recent Publications

Social, Institutional, Disciplinary, and Policy Studies

Nedo Gelsomini. "La chimica a Firenze nell'800 e il Museo di Storia naturale." *ICS (Innovazione—Comunicazione— Sviluppo)* 92(7/8) (1992), 9–11.

Eckart Henning; Marion Kazemi. *Chronik der Max-Planck-Gesellschaft zur Förderung der Wissenschaften unter der Präsidentschaft Otto Hahns (1946–1960).* Berlin: Veröffentlichungen aus dem Archiv zur Geschichte der Max-Planck-Gesellschaft, 1992. Includes a list of KWG institutes and research centers at the end of World War II.

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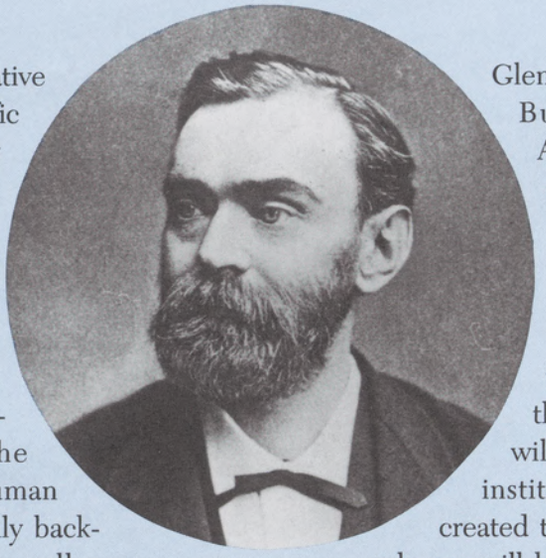

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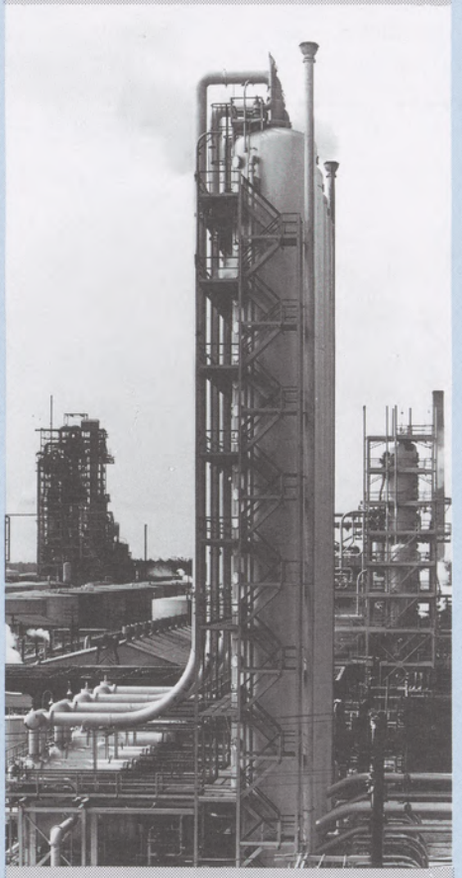

A naphtha-fractioning tower at Exxon's Baytown, Texas petroleum refinery, 1949. Courtesy Exxon Corporation.

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———. "Some Key Historical Highlights in the Evolution of the Modern Concept of Valence." *Journal of Molecular Structure (Theochem)* 259 (1992), 1–28.

Continued on next page

Travis Consults on Dyes

This spring CHF convened a distinguished advisory group to explore ways and means of creating a traveling exhibit on the history of dyestuffs and their production. The group met with Anthony S. Travis of the Sidney M. Edelstein Center for the History and Philosophy of Science, Technology, and Medicine at the Hebrew University in Jerusalem. On the same occasion Travis launched his book *The Rainbow Makers* and gave a well-received public lecture on the development of the synthetic dyestuffs industry.

Travis lectured on synthetic dyes in the CHF gallery, surrounded by an exhibit on Alfred Nobel and his legacy, created by the Nobel Museum of Sweden and the Nobel Foundation.

Yanis Bibelnieks, consultant to dye industries and one of the advisers on the traveling dyestuffs exhibit, is seen here with Edmund H. Fording, President of U.S. Operations, Dyes and Chemicals Division of Crompton & Knowles, and John C. Haas of Rohm and Haas.

ARCHIVES

Donations to CHF

A Major Gift to the Julian Archive

In January of this year Percy L. Julian, internationally renowned steroid chemist and industrial entrepreneur, was honored with a United States postage stamp showing him at work in his laboratory (*Chemical Heritage* 10:2, Summer 1993, p. 28). Almost at the same time, a major addition to CHF's Julian archive was sent to us by **Ray Fields Dawson,** professor emeritus of Columbia University. Dawson was introduced to natural products research as an undergraduate student of Julian's at DePauw University (see 7:3, Fall 1990, p. 6). After joining the Columbia faculty, Dawson helped Julian with Central American business ventures, establishing plantations of the yams and other plants from whose diosgenin extracts Julian then synthesized cortisone and related steroids. The detailed business and personal correspondence in this gift documents the complexities of industrial activity in Mexico and Guatemala in the late 1950s, Julian's superb entrepreneurial skills, and the eventual sale of a major operation to the Upjohn Company. This gift joins Bernhard Witkop's of his decades-long correspondence with Julian, which culminated in Witkop's successful nomination of Julian to membership in the National Academy of Science as its first African-American (see *Chemical Heritage* 10:1, Winter 1992–93, p. 11).

L. マイヤー(LOTHAR MEYER 1830-1895)

ドイツの化学者ならびに物理学者．1854年ヴュルツブルグで医学の学位をとり，それからハイデルベルクで化学を，ケーニヒスベルクで数理物理学を学んだ．彼はブレスラウおよびカールスルーエ(1868年から)の大学で教鞭をとり，さらにチュービンゲン大学(1876年から1895年まで)で化学の教授をつとめた．普仏戦争(1870-1871)の間，大学が病院に転用されたため，カールスルーエで軍医として活動した．

1860年，カールスルーエで開かれた国際化学会議に出席した彼は，カニッツァーロの影響を強くうけた．彼の著書"最新化学通論"は化学の諸概念を明確化するうえに力があった．1869年，彼は原子体積，融点，揮発性，展性，脆性，および電気化学的性質などの周期性の実例を多く示して，元素の周期的分類に対する証拠を発表した．マイヤーとメンデレーエフは，それぞれ独立に周期律を確立した．その功績により，彼らは共々にイギリスの王立学会からデーヴィー賞牌を贈られた．

マイヤーの初期の研究は血液の化学であったが，後年は多数の有機化学および無機化学の研究のため60名からの博士課程学生の指導にあたった．彼はまた，高校および大学の教育問題についても熱心な興味をもっていた．

The Chemical Bond Approach, or CBA, high-school curriculum project developed the text Chemical Systems, *which was translated into Japanese by a team directed by Bunichi Tamamushi, a colloid chemist and founder of Tokyo University's History and Philosophy of Science Department. Iwanami Shoten published it.*

CBA and Blood Plasma

The Chemical Bond Approach Project was the first national high-school chemistry project to be supported by the National Science Foundation after Sputnik went up. In 1959 the project's future director, **Laurence E. Strong** of Earlham College, suggested at a conference on high-school chemistry at Reed College that chemistry teaching needed conceptual coherence, not the recital of a mere succession of topics. He was urged to create a syllabus. After the usual travails CBA was funded and published, and teachers were trained to teach it. Strong has given CHF early correspondence and early trial printings of CBA materials, as well as Japanese and Brazilian versions, allowing future scholars to trace this major educational innovation.

During World War II Strong worked at Harvard Medical School with Edwin J. Cohn, John T. Edsall, George Scatchard, and others in a program on blood plasma fractionation and blood substitutes. A paper Strong coauthored with Cohn and others on large-scale blood fractionation (*Journal of the American Chemical Society*, 68[1946], 459–475) became one of the most highly cited papers compiled by the Institute for Scientific Information. A second donation contains the project's official manuals, memoranda, and reports from 1941 to 1946, as well as journal reprints to 1949.

Daniel Conlon and I^2R

The firm Instruments for Research and Industry, better known as I^2R, was the brainchild of **Daniel Conlon.** It is a "small technically oriented company with a conscience," as a cartoon published in *ChemTech* puts it. Conlon has donated his memoirs, "Memories of a Creative Life," which tell of his early work at Rohm and Haas and his love of practical jokes, as well as of his own company's development of control equipment—safeguarding researchers and reactions—and user-friendly items such as lead doughnuts for keeping Erlenmeyers upright.

Nobel Laureates in CHF Archives

We have periodically informed our readers of the deposits at CHF of U.S. and international records, made by the Commission of Atomic Weights and Isotopic Abundances of the International Union of Pure and Applied Chemistry. Tyler

PUBLICATIONS—*continued from previous page*

Alchemy and Chemistry through the Eighteenth Century

Roger Bacon. *The Mirror of Alchimy: Composed by the Thrice-Famous and Learned Roger Bachon Fryer.* New York/London: Garland Publishing, Inc., 1992.

F. Habashi. "Chemistry and Metallurgy in the American-Indian Empires." *CIM Bulletin* 85(965) (Nov./Dec. 1992) 103–108.

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Ken Reese. "Breaking the Alchemy Code." *Today's Chemist At Work* 2(5) (May/June 1993), 57–58. On the studies of Lawrence Principe.

R. Werner Soukup. "Das Alchemistenlaboratorium von Oberstockstall: Ein Vorbericht zum Stand des Forschungsprojekts." *Mitteilungen der Gesellschaft Deutscher Chemiker: Fachgruppe Geschichte der Chemie* No. 7 (1992), 11–19.

General

Bernadette Bensaude-Vincent; Isabelle Stengers. *Histoire de la chimie.* Paris: Éditions la Découverte, 1993.

Luis Cortes. "The Use of Problem-Solving in the History of Chemistry Course." *Journal of Chemical Education* 69 (1992), 1012–1013.

Mary Jo Nye; Joan L. Richards; Roger H. Stuewer, eds. *The Invention of Physical Science: Intersections of Mathematics, Theology, and Natural Philosophy since the Seventeenth Century. Essays in Honor of Erwin N. Hiebert.* Norwell, Mass.: Kluwer, 1992.

B. Coplen, Secretary of the Commission, informs us that these documents include information on a number of Nobel laureates: Francis W. Aston (Nobel Prize, 1922), Marie Curie (1903, 1911), Henri Moissan (1906), Wilhelm Ostwald (1909), Theodore W. Richards (1914), and Frederick Soddy (1921).

Polymer Chemist and Chinese-American

Jesse C. H. Hwa, a native of Shanghai with a Ph.D. from the University of Illinois and president since 1985 of Hwa International of Stamford, Connecticut, has sent us his *ACS Polymer Chemistry Division: Celebrating 40 Years, 1951–1991,* an offprint of *Polymer Preprints* 32(2) (May 1991), 311–417. Accompanying this document was Hwa's *The Founding and the Early Years of the Chinese American Chemical Society (1981–1985).* Hwa chaired the ACS Division of Polymer Chemistry in 1973 and has chaired its Historical Committee since 1988. He was also president for two terms of the Chinese American Chemical Society.

Hwa was among the Chinese-American members of ACS who participated in exchanges between U.S. and Chinese chemists after President Nixon's "Opening to China."

The priceless Solvay archives were preserved thanks in large measure to Sarah Auchincloss, center, great granddaughter of one of the two founders, and Daniel W. Casey, left, former chairman of the board of the Solvay Public Library. They are seen here with Fran Quatrone at the formal opening of the Solvay Process Room, 7 December 1986.

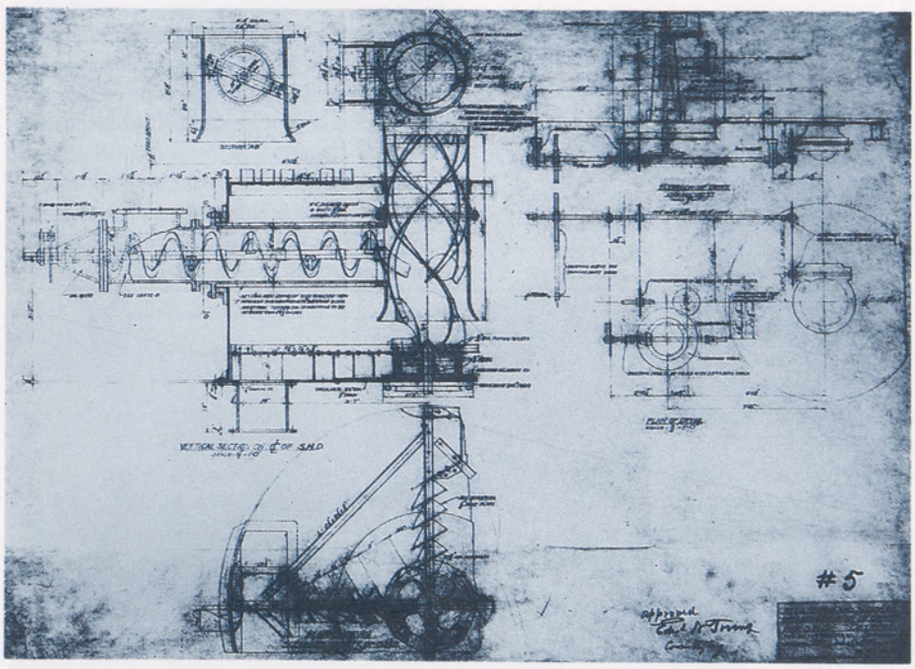
The Treasures of Solvay

An extraordinary treasure trove of early American chemical engineering awaits the traveler to upstate New York. There, in a climate-controlled room of the Solvay Public Library in Syracuse, lie the documents that detail an amazing American adventure. In the mid-nineteenth century Rowland Hazard was looking for a new investment after a successful career in sheep raising and wool production. Recognizing how ample limestone and underground salt deposits were in the Syracuse area, and capitalizing on their proximity to the Erie Canal, he and William Cogswell decided to bring the Solvay process for soda and fertilizer production to the United States. Operations began in 1881. Allied Chemical took over the Solvay Process Company in 1920 and finally closed its operations at Solvay in 1986.

Rowland Hazard's great-granddaughter Sarah K. Auchincloss, on discovering that Allied was not interested in Solvay's early archives, set about obtaining them. She joined forces with Daniel W. Casey, chairman of the board at the Solvay Public Library, and the two succeeded in bringing the archives to the library for preservation. Their most remarkable aspect is the seemingly complete technical documentation of the early manufacturing equipment: many of the drawings are hand-drawn and colored on linen, and a first-person account by E. N. Trump, the supervising engineer, describes the equipment's construction.

Also in the collection is a 614-page handwritten translation of a work in Russian, J. R. Goldstein's *Production of Calcined Soda* (1934). It describes the basic chemistry and technology of the Leblanc and Solvay processes and the soda industry in the USSR.

As a safety precaution, the Solvay Public Library microfilmed the technical documents and the hundreds of photographs in the Solvay archives, and many other items of interest. Through the generosity of Sarah Auchincloss and of a second descendant of Rowland Hazard, Constance Witherby, a copy of the microfilm is now part of the CHF archives so that visitors to Philadelphia can obtain a preview of the Solvay treasures. The gift also made possible the deposit of a second Solvay microfilm at our sister institution, the Edelstein Center in Jerusalem.



Original drawings, forerunners of the blueprint, many on linen, document the technical details of Solvay production, here the cooling and crystallization chamber for sodium sesquicarbonate. Both pictures courtesy the Solvay Public Library.

The First Century of Chemical Engineering: Timeline Now Available

When did chemical engineering begin? The cover of *Perspectives in Chemical Engineering*, edited by Clark K. Colton (*Chemical Heritage* 10:1, Winter 1992–93, p. 16), announced "A Century of Chemical Engineering, 1888–1988," dating the discipline from Lewis Mills Norton's *course* on the subject at MIT. The University of Pennsylvania celebrated the centennial of "the first" chemical engineering *department* during 1993 (see article on p. 25). The first *lectures* on unit operations had already been given in 1887 by George E. Davis at Owens College, Manchester. Success has many fathers! What is clear is that we now enjoy the fruits of a century of chemical engineering achievement. With that in mind, CHF is publishing and distributing a chemical engineering timeline, which will have its public unveiling at the eighty-fifth anniversary celebrations of the American Institute of Chemical Engineers in St. Louis, Missouri, in November. Prepared by CHF's James J. Bohning, it seeks to portray the beginnings and meteoric rise of chemical engineering as a profession, and the various changes in focus and direction during its growth.

The first two sections take the story to 1913. During this time, in the words of Sir Harold Hartley, "from their experience in chemical plants, both chemists with an instinct for engineering and engineers with a taste for chemistry grew into chemical engineers without realizing it." Chemical engineering entered academic curricula; chemical engineering societies were founded, and journals were launched. This phase also saw the founding of General Bakelite Corporation (1910), and the first use of high-pressure technology in a chemical plant, the Haber-Bosch ammonia process (1913).

The major theme for 1914–28 is unit operations. In this period the U.S. chemical industry turned its attention to dyes, pharmaceuticals, and other organic chemicals, and consumer demand led to rapid expansion of the petroleum industry. The years 1929–39 saw the introduction into student curricula of calculation of material and energy balances and the transition from batch to continuous processes in the petrochemical industry. Plastics and synthetic fibers were transforming industry as well as consumer lifestyles.

The last three sections cover the changes brought on by World War II (1940–49); the 1950s and 1960s, when chemical engineering became markedly interdisciplinary as it entered the arenas of biology and environmental sciences; and the last two decades, which saw chemical engineering becoming—if possible—even more important to all aspects of our economy and our daily lives.

Single copies of the timeline are available free of charge from CHF.

Warren K. Lewis teaching at the Chemical Engineering Practice School at the Bayway Refinery, Standard Oil Company (New Jersey). Courtesy MIT Museum.

Warren K. Lewis Leaves the Farm

At the lecture L. E. Scriven gave this spring as part of centennial celebrations of the University of Pennsylvania's chemical engineering department (see p. 25), Stuart W. Churchill recalled Warren K. Lewis's story about his decision to do doctoral work. Churchill heard it during "An Evening with Doc Lewis," held at the 57th Annual Meeting of the AIChE in Boston on 7 December 1964.

Lewis recounted that when he was a senior in 1905, Professor William H. Walker called him into his office and proposed that he apply for a fellowship that would allow him to obtain a doctorate in Breslau (then part of Germany). Lewis said he was not planning to do graduate work because he had promised his father to return to the farm in Delaware after completing his bachelor's degree. Walker said MIT was very honored to be able to nominate a candidate, that he hoped Lewis would apply out of loyalty to MIT, and that in any event Lewis was unlikely to be selected. Lewis was nonetheless chosen in due course, and he convinced his father to allow him to accept the fellowship because of the great honor attached. Soon after returning to the United States with the degree, Lewis accepted a teaching position at MIT and remained there the rest of his career. Years later Lewis was cleaning out Walker's files following the latter's death. There he discovered the fellowship file and a note: "Persuaded young Lewis to apply for fellowship at Breslau. As the only candidate he is certain to be chosen."

STUART W. CHURCHILL
University of Pennsylvania

Summer Issue Mailing Alert

Chemical Heritage 10:2, Summer 1993, was mailed in mid May. So that the issue will reach our readers sooner, the labels are now being generated by our printer, The Sheridan Press. For the summer issue, however, the labels for subscribers with departmental addresses were not generated correctly. If the summer issue did not reach you, please contact CHF.

PUBLIC OUTREACH

An Electronic Highway for Chemical History Teaching

High school chemistry teachers now seek to integrate the human dimension—the story of chemical scientists and the chemicals they work with—into their teaching. The Chemical Heritage Foundation is moving to support that endeavor. In 1991 it held a one-week workshop focusing on the development of the periodic table, with William Jensen of the University of Cincinnati, editor of the *Bulletin for the History of Chemistry*, as lecturer. In 1992 CHF, together with the Woodrow Wilson National Fellowship Foundation, organized a month-long summer institute led by Derek A. Davenport of Purdue University and CHF's Lawrence B. Friedman. Fifty outstanding teachers were selected from a large nationwide pool of applicants.

One problem teachers face is easy access to sources and knowledgeable individuals. An electronic network linking teachers to CHF and to each other would be a major step forward. In summer 1993 Lawrence Friedman ran a pilot project to test its feasibility. Daniel S. Lane of University City Senior High School in St. Louis, Missouri, and Lynn L. Snyder of Agnes Irwin School in Rosemont, Pennsylvania, were linked with CHF, with Susan Speaker, a graduate student in history of science at the University of Pennsylvania, and with David A. Katz of the Philadelphia College of Pharmacy and Science.

This first summer all four explored the network's capabilities, prepared several history of chemistry modules for use in introductory chemistry, and developed ancillary materials linked to the modules and helpful in teaching.

A bibliography on history of chemistry aimed at chemistry teachers was prepared at CHF. Network participants increased its value by annotating it. The bibliography, long sought for by our readers, will be made widely available.

CHF Exhibits on the Road: 1994

Our traveling exhibits are becoming widely known, and reservations need to be made early. The only cost is that of return shipping. Write to Exhibits at the Chemical Heritage Foundation.

Exhibit itineraries for 1994 are as follows:

Woodward and the Art of Organic Synthesis
15 January–1 March: Berman Museum of Art, Collegeville, PA
7–31 March: Milton J. Rubenstein Museum of Science and Technology, Syracuse, NY
April: Harvard University, Cambridge, MA
15 May–30 June: Joint Meeting of the ACS Great Lakes Region and Central Region, University of Michigan, Ann Arbor, MI
24 July–7 August: ACS Division of Chemical Education 13th Biennial Conference, Bucknell University, Lewisburg, PA
October: University of Missouri, Columbia, MO

Polymers and People
1 March–15 April: Aitken Bicentennial Exhibition Center, Saint John, New Brunswick, Canada
Summer: Institute of Polymer Science, University of Akron, Akron, OH.

Scaling Up
1 March–15 April: Aitken Bicentennial Exhibition Center, Saint John, New Brunswick, Canada

Structures of Life
15–31 October: University of Missouri, Columbia, MO
November: Las Cruces Natural History Museum, Las Cruces, NM

From our Far-Flung Correspondents

Ernest M. May of Summit, New Jersey, wrote to supplement Kathryn Steen's report on dyes transported on the German U-boat in 1916 (*Chemical Heritage* 10:2, Summer 1993, pp. 6–7). May chaired the International Relations Committee of the Synthetic Organic Chemicals Manufacturing Association during the so-called Kennedy Round of trade negotiations.

"The principal cargo, indigo, of the German chemical U-boat was destined for the predecessor of Cone Mills Corp. Cone is still the world's largest consumer of indigo for blue jeans denim. The American Dye Institute, predecessor of SOCMA, in order to compete with IG Farben, fought for and obtained duties based on American Selling Price (ASP) for benzenoid chemicals and dyes manufactured in the United States. These duties were rescinded some years after the Kennedy Round with the result that the U.S. dye industry is now largely [except for Crompton & Knowles] a subsidiary of German, Swiss, British, and Japanese manufacturers. SOCMA has the whole story in its files."

Larry Mirel of Washington D.C. wrote us about the **Emeritus Foundation.** It recruits retired scientists and engineers to work with elementary-school students, introducing them to the working world of science and technology. Volunteers spend an hour a week for six weeks in the classroom and also take the students to a laboratory or industrial facility. Currently the program operates only in and near Washington, but the Foundation hopes to extend it further. If you want to participate or help bring

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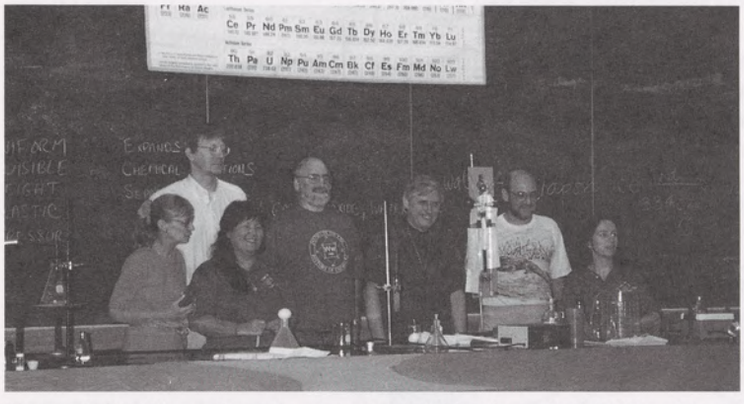
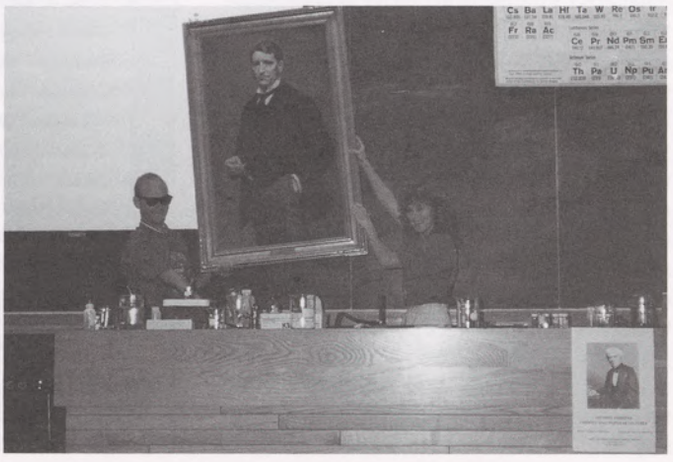




How to bring history into the classroom will be the task of CHF's electronic network. Scenes from the 1992 teacher workshop. Courtesy Alice Veyvoda.

CORRESPONDENTS—*continued*

the program to your community, give Larry a call at (202) 232-0863.

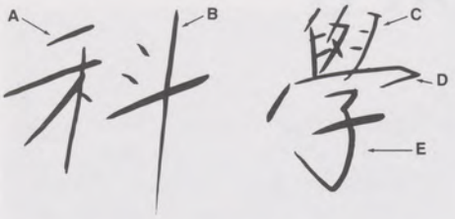
W. G. Pohl of Linz University chairs the Austrian Chemical Society's history of chemistry "Working Party," which he founded. He wrote that he and some Swiss colleagues are heading an oral history program, while other members are working on alchemy, on the centennial of Josef Loschmidt's death (1898), and on the hundredth anniversary of the Austrian Chemical Society in 1997. Pohl also notes that the Austrian Society's *Chemie und Schule*, which he edited for six years, carries a continuing series of history of chemistry articles in response to intense student interest.

Pohl is also assembling information on the German dye chemist Paul Friedländer, who lived in Vienna 1895 to 1911, when he was investigating the dye known as Tyrian, Phoenician, or royal purple.

760mm: Three years ago we asked readers for information on the origin of 760 torr as standard pressure. Now **Jean Scurlock** of Kansas City, Missouri, has sent us her unpublished manuscript "Laplace and the Level of the Sea," together with background materials for CHF's archives.

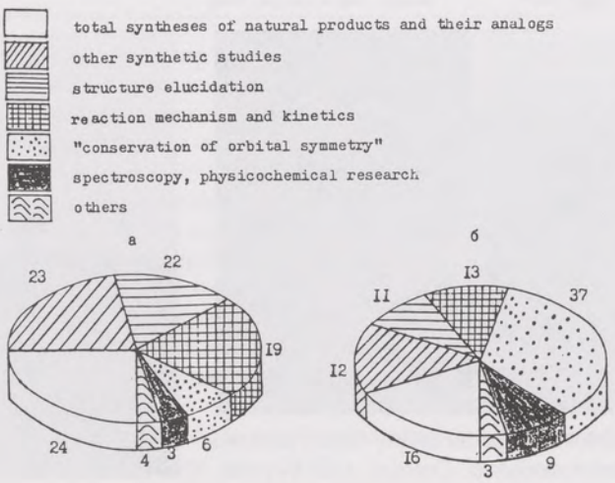
Standard atmospheric pressure was first officially defined by the Comité International des Poids et Mesures on 8 October 1878, as equal to that of a mercury column 760mm high at O°C, at 45° latitude, and at sea level. The committee based its choice on a definition it attributed to Pierre Laplace. But Laplace only comes close to a definition in the fourth edition of his *Exposition du Système du Monde* (1813); moreover, he specifies the latitude as 50°. Who first measured the mercury column as 760mm is unclear.

Woodwardometries: Boris L. Milman of the State Institute of Applied Chemistry, St. Petersburg, Russia, sent us his scientometric analysis of the works of Robert B. Woodward. In order to gauge the scientific importance of Woodward's eighteen syntheses, Milman uses indices measuring complexity of the molecule, number of synthetic steps, citations, and evaluations by biographers. Although syntheses occupy the largest group of papers, Woodward's theoretical contributions (orbital symmetry, ultraviolet spectra, etc.) made the greatest impact.



The Chinese ideograms for kagaku, *"science." A is the symbol for grain, hence important, vital;* B *is cup or measure, hence quantitativeness. The second symbol, simplified in Japanese script, stands for study (as in* daigaku, *"university"). C depicts the hands of the master, and* D *the roof under which the young person* E *has his ignorance dispelled. From* ChemTech *10 (Dec. 1980), 721. Courtesy American Chemical Society and Paul B. Weisz.*

Paul B. Weisz, formerly a senior scientist at Mobil Corporation and Distinguished Professor Emeritus of Bioengineering and Chemical Engineering at the University of Pennsylvania, wrote us from State College, Pennsylvania, in response to the depiction in our last issue (p. 25) of the Japanese symbols for *ka* in *kagaku*, which may mean "chemistry" or "science" depending on which Chinese ideogram is used. He enclosed a copy of a discussion he published in *ChemTech* of the composite nature of the symbols for *kagaku*, as "science." By contrast the symbols for *kagaku*, "chemistry," mean the study of change. They were proposed by a British missionary in Shanghai, Alexander Wiley, to distinguish modern chemistry from alchemy—the craft of making gold or elixirs. The Western word *chemistry*, on the other hand, according to Joseph Needham, may be derived from *kin*, the Chinese word for gold.



Distribution of (a) Woodward papers (1934–90) and (b) citations to them (1945–89), as percentages of the totals (221 papers, 20,806 citations) by research field. Courtesy Boris Milman and Zhurnal Vsesoyuznogo Khimicheskogo Obshchestva Imeni D. I. Mendeleeva, *from 36 (1991), 493–99.*

Paris Club for History of Chemistry

The Club d'Histoire de la Chimie was founded in 1992. Its goal is to promote the history of chemistry to various audiences in France and elsewhere. Contact Monique Monnerie at the Club, ESPCI, 10 rue Vauquelin, 752431 Paris Cedex 05, France.

Chemical Heritage Salutes AACC's *History*

The American Association for Clinical Chemistry, one of CHF's newer affiliates, established its Division on the History of Clinical Chemistry in 1991. The division's quarterly newsletter, *History*, edited by Nathan Radin, is already in its second volume. *History* is looking for one or more assistant editors as well as contributions—not financial but written—for inclusion in its pages. The spring 1993 issue carried Stanley Morgenstern's story of the "robot chemist" of the late 1960s, a machine designed to dispense samples to various modules which then carried out clinical measurements. The concept was good, but design limitations doomed it.

Last summer the history division held a symposium at the AACC National Meeting on the historical development of instrumentation in clinical chemistry. CHF cooperated with the division in setting up its booth at the meeting, designing displays especially for the meeting's attendees.

The history division is chaired by Samuel Meites of the Children's Hospital, Cincinnati, author of the much-praised biography of the pioneer of clinical chemistry Otto Folin.

MEETINGS

AIC National Meeting, Indianapolis, Indiana, 2–6 March 1994.

207th ACS National Meeting, San Diego, California, 13–18 March 1994.

HIST Program Chair: M. D. Saltzman, Department of Chemistry, Providence College, Providence, RI, 02918; (401) 865-2298. Send four copies of abstract for general papers sessions to M. D. Saltzman by 1 December 1993. The HIST program includes a symposium, "National Historical Chemical Landmarks," organized by Jeffrey L. Sturchio, Merck & Co., P.O. Box 100 Whitehouse, Station, NJ 08889-0100, (908) 423-3981.

AIChE 1994 Spring National Meeting, Atlanta, Georgia, 17–21 April 1994.

ASBMB National Meeting, Washington, D.C., 15–19 May 1994.

Electrochemical Society Spring National Meeting, San Francisco, California, 22–27 May, 1994.

ASMS Annual Meeting, Chicago, Illinois, 29 May–3 June 1994.

AACC Annual Meeting, New Orleans, Louisiana, 17–21 July 1994.

Alpha Chi Sigma Annual Meeting, Minneapolis, Minnesota, 2–7 August 1994.

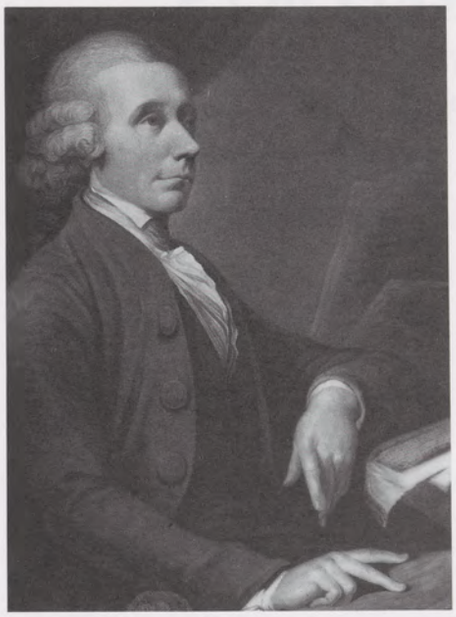
208th ACS National Meeting, Washington, D.C., 23–28 August 1994.

Send four copies of abstract for general papers sessions by 1 May 1994 to M. D. Saltzman (see address above). The HIST program will include two symposia: "IUPAC 75th Anniversary," organized by M. D. Saltzman; and "Archaeological Chemistry," organized by Mary Virginia Orna, College of New Rochelle, New Rochelle, NY 10809, (914) 854-5302.

Electrochemical Society Fall National Meeting, Miami Beach, Florida, 9–14 October, 1994.

AATCC International Conference and Exhibition, Charlotte, North Carolina, 11–14 October 1994.

AIChE National Meeting, San Francisco, California, 13–18 November 1994.



Joseph Priestley (left) and Antoine Lavoisier (right).

Georgius Agricola Quincentennial, 1994.

For details on celebrations, including conferences, excursions, and an exhibit at the Schlossbergmuseum in Chemnitz, write the secretaries of the planning committees, Gert Richter or Herbert Pforr, Bergakademie Freiberg, Agricola Ehrungen 1994, Komitee Montanwesen, Box 47, 0-9200, Freiberg, Germany.

Priestley and Lavoisier Bicentennials

In 1794 Antoine Lavoisier was guillotined in Paris, and Joseph Priestley escaped from Birmingham to Northumberland, Pennsylvania. Priestley was one of the discoverers of oxygen; Lavoisier believed it was an element and built his system of chemistry around it, a system opposed by Priestley. On 24–27 June 1994 the ACS and the Royal Society of Chemistry are holding a Priestley conference at Bucknell University, near Priestley's home. The gathering is the seventh in a series of Priestley conferences sponsored by the British Oxygen Company (BOC). The first was held in 1974, the year that marked the bicentennial of Priestley's discovery of oxygen.

The conference "The Chemistry of the Atmosphere," will cover oxygen and ozone, O_3; it includes a symposium on the history of ozone, discovered by Christian Schönbein in 1839, 150 years ago. The Pennsylvania Historical and Museum Commission will host the celebrations, which will include an exhibition, "Joseph Priestley's American Legacy," that uses fine arts to illustrate social history, and the first family reunion ever held for the descendants of the Priestley family in America.

Priestley was the subject of the first CHF traveling exhibit, now permanently on view in the Joseph Priestley House in Northumberland. The accompanying booklet by David J. Rhees, *Joseph Priestley, Enlightened Chemist*, will be updated and reissued by CHF and made available when conference participants tour the house.

The bicentennial of the death of Lavoisier, whose 250th birthday was celebrated last year, is being commemorated in Paris on 3–6 May. Included will be visits to Lavoisier's laboratory and to his former holdings in the Blois region. (For information write Bicentenaire Lavoisier, Académie des Sciences, 23 Quai Conti, 75006 Paris.) Our readers may also be interested to learn, as we were, that in 1894 an international commemoration of Lavoisier was held in Russia. Among the participants was Vladimir Ipatieff, who described it in his *Life of a Chemist*.

A major new biography, *Antoine Laurent de Lavoisier, 1743–1794*, by Jean Pierre Poirier (Paris: Pygmalion/Gérard Watelet), appeared in 1993; this social history examines Lavoisier's science, his government service, and his role in French finances and early economic thought.

CONFERENCE REPORTS

Second Jerusalem International Workshop on the History of Chemical Technology

Scholars from The Netherlands, Britain, Poland, the United States, and Israel gathered in Jerusalem in April 1993 for the Sidney M. Edelstein Center's second international workshop on the history of chemical technology. Like the first workshop, held in 1990, the central theme was dyestuffs, in keeping with the main focus of the Edelstein Collection at the Hebrew University.

The first session concerned the natural red colorant from the madder root that was once famous in Turkey red dyeing. Johan Schot (Twente, The Netherlands) described the Dutch style of madder production in the eighteenth and early nineteenth centuries and diffusion of the method across Europe. The Dutch product was renowned for the quality control exercised. Ido Yavetz (Edelstein Center) described the efforts of the famous entomologist and anti-evolutionist Jean Henri Fabre to make his fortune by improving madder production in Avignon, France, in the mid 1860s; he failed because synthetic alizarin, the main dye in madder, entered the market in 1869. Anthony S. Travis (Edelstein Center) summarized the dyes, both natural and synthetic, that were widely available during the 1860s and examined the stimuli that encouraged the search for novel synthetic products.

Willem J. Hornix and Elisabeth Thijsen-Visser (Nijmegen, The Netherlands) presented a new interpretation of the discovery of commercial azo dyes in the latter part of the 1870s, based on original source material, which they compared with accounts put out by biographers and participants.

Ernst Homburg (Maastricht, The Netherlands) examined German polytechnic education, especially in chemistry, from 1803 to 1863, during which time demands and needs changed dramatically. Contrary to the standard story of advances in chemical education, as described by Liebig and others, polytechnic institutes were well ahead of universities during most of that period, training the colorists and chemical analysts essential to the emergence of the synthetic dyestuffs industry.

Kathryn Steen (University of Delaware; Edelstein International Student) brought the dye story into the twentieth century with a study of American agents for German chemical firms during World War I. The agents grappled with their obligations to Germany, growing anti-German sentiment, and threats to their own survival while responding to the strategic needs of the U.S. chemical industry. The modern organic chemical industry emerged as a major force in the United States during the years that followed.

The second session covered more recent areas of organic chemistry. Peter J. T. Morris (Science Museum, London) discussed the problems of writing the history of R. B. Woodward's brilliant organic syntheses, in particular his collaboration with Albert Eschenmoser of the ETH in Zurich, which led to the total synthesis of vitamin B_{12} in 1973. Tobacco, alcohol, and sheer arrogance drove forward the enterprise, as the number of steps reached well over one hundred. The failure of nature to obey Woodward in one early step led to the formulation of the principles of conservation of orbital symmetry, which would have given Woodward a second Nobel Prize in chemistry had he not died at age sixty-two.

Michael Chayut (Hebrew University) examined polymer research and its influences on fundamental science, using Joseph Ben-David's sociological model of peripheries and the growth of knowledge. Wallace Carothers and Paul Flory made major contributions in these fields once Du Pont increased its research into new materials.

The last session moved back to medieval times. Grazyna Rosinska (Polish Academy of Sciences, Warsaw) reported on surviving documents from the University of Krakow, some dispersed throughout Europe. These archives allow a picture to be drawn of the activities at a typical central European university in the fifteenth century. Finally, Moshe Ron (Edelstein Library) corrected many accepted ideas about the alchemist and outlined the range of instruments used in early manipulations of natural materials.

The proceedings of the first Edelstein workshop were published in the *British Journal for the History of Science* 25, (1992), 1–167. See *Chemical Heritage* 10:2, Summer 1993, p. 17; and the story on the workshop in 8:1, Spring 1991, p. 4.

Madder. From Theodore Zwinger, Herbarium *(1696)*

Writing History of the Chemical Sciences

Nearly a dozen books on the history of the chemical sciences and chemical process industries have appeared during the last two years. Not surprisingly, meetings have been held to examine the problems faced by contemporary authors in communicating this subject to diverse audiences of chemists, historians of science, students, and laymen. One such meeting, organized by the Society for the History of Alchemy and Chemistry (SHAC) was held at the Science Museum, London, on 22 May; a week later there followed a colloquium, "Ecrire l'histoire de la chimie," at the University of Paris, Nanterre, organized jointly by John Brooke of the University of Lancaster, U.K., and Bernadette Bensaude-Vincent, Paris.

The SHAC meeting included viewing a visually stunning Open University teaching film, "The Publicity of Oxygen," in which Colin Russell (Open University) and Bensaude-Vincent starred alongside Joseph Priestley, Carl Wilhelm Scheele, and Antoine Lavoisier. Noel Coley, introducing the film,

drew attention to the care with which the film avoided or explained technical vocabulary. The film is expected to attract large audiences on BBC television over a three- or four-year period. Other contributors that day included Brooke and three authors of works in history of chemistry aimed at wide audiences: William H. Brock (Leicester; *The Norton History of Chemistry*), David M. Knight (Durham; *Ideas in Chemistry*) and John Hudson (Anglia Polytechnic University; *The History of Chemistry*). In addition, Peter Morris of the Science Museum examined some of the difficult issues involved in displaying twentieth-century chemistry at the Science Museum, where he is about to rearrange the Chemistry Gallery.

The Nanterre colloquium was held in a room the size of an aircraft hangar, with delegates seated dauntingly at an enormous oblong of microphone-crested tables. Any semblance to a meeting of European Economic Community politicians was dispelled when speakers reviewed earlier centuries' attempts at writing the history of chemistry. John Christie (Leeds) analyzed the polemical intentions of Hermann Boerhaave and William Cullen in their undergraduate lectures at Leyden, Glasgow, and Edinburgh; Alan Rocke (Case Western Reserve) showed that Charles Adolphe Wurtz's historical writings had to be placed in the context of France's needs to modernize its chemical *and* historical scholarship in the face of German competition; while Günter Schiemenz (Kiel) argued that Albert Ladenburg's historical writings formed part of the effort to promulgate structural chemistry. Other pre-lunch contributions came from Russell, on the value of local studies in historical writing, and, more philosophically, from Pierre Laszlo (Ecole Polytechnique), on the complementarity of the competences of chemists and historians.

There followed a roundtable discussion "animated" (as the French more aptly describe a chairperson's task) by Christie, in which Fred Aftalion (Total Chimie, Paris; author of *A History of the International Chemical Industry*), Isabelle Stengers (Brussels) and Bensaude-Vincent (coauthors of *Histoire de la Chimie*), Brock, and Knight reflected on their different approaches to, and styles of, historical narration. Discussions focused on the origins and takeoff point of chemistry as a discipline and (as at the SHAC meeting) on how to write for nonchemists about twentieth-century chemistry. After Anousheh Karvar (Bibliothèque de France) described her library's project to create an electronic library of chemical texts and correspondence, speakers moved to the Restaurant Fournaise depicted in Renoir's picture of the boating party's luncheon.

WILLIAM H. BROCK

For a review of the Brock, Hudson, and Knight books see *Chemical Heritage* 10:2, Summer 1993, p. 14; for Aftalion, see 8:2, Fall 1991, p. O-12.

Europe Looks at Chemical History

A five-year program of conferences and publications on the history of chemistry, 1789–1918, has been launched by the European Science Foundation as its first interdisciplinary project. The program has four foci: communication in chemistry; chemistry and human welfare; the chemical industry and the transfer of chemical expertise; and the emergence of the chemist. International similarities, relationships, and differences will be examined during a period when chemistry was almost exclusively a European science. For information write David Knight, Philosophy Department, University of Durham, 50 Old Elvet, Durham DH1 3HN, U.K.

Cleveland Chemists Celebrate

The following is adapted from the program brochure of the one-hundredth Anniversary Celebration of the Cleveland Chemical Society, held 17 February 1993. When after sixteen years of independent existence the organization joined the American Chemical Society in 1909, it became the thirty-first local section. The table lists the dates of ACS affiliation for the earliest continuing local sections (New Orleans is no longer active).

Cleveland's chemical history began with the founding of the city by Moses Cleaveland in 1796. In these early days, Cleveland's chemical industries employed simple chemical processes that characterized frontier life throughout the country. In 1840, Cleveland produced 115 tons of potash, 53 tons of soap, and 25 tons of candles, and 13 tanneries were listed in the city directory. . . .

However, the iron, steel, paint, varnish, petroleum, and heavy chemical industries truly prepared the way for Cleveland's future industrial importance. With the discovery of iron ore in Michigan in 1844, Cleveland's iron and steel industry was off and running. . . . Cleveland's petroleum industry followed closely upon the heels of the iron and steel industry, after the discovery of oil in Titusville, Pennsylvania. . . . Three sulfuric acid producers began operations in the years 1865–67: the Cleveland Chemical Company, Eugene Grasselli and Son, and Marsh and Harwood, the latter two moving in from Cincinnati. . . .

With such a large chemically dependent industrial base, it is not surprising that the small but growing number of professional chemists should want to form an organization to further the growth and appreciation of chemistry. On 15 February 1893 a letter was sent out to all the professional chemists of Cleveland inviting them to a meeting on 21 February to consider the advisability of forming a local society of chemists. About thirty chemists assembled, and after a preliminary meeting they organized regularly on 6 March 1893 to form the Cleveland Chemical Society. They elected Cleveland's outstanding academic chemist of that day, Professor Edward W. Morley, of Western Reserve University, as its first president. . . . He was followed by Charles William Mabery, from the Case School of Applied Science. . . . Mabery early became interested in Cleveland's petroleum industry, eventually publishing over 100 papers and inspiring many chemists to enter the expanding Cleveland chemical industry. One of his outstanding students was Herbert Dow, a graduate of the class of 1888. . . .

In 1909 the Cleveland Chemical Society affiliated with the American Chemical Society, which had formed in 1876 at the Priestley house in Northumberland, Pennsylvania, on the hundredth anniversary of the discovery of oxygen by Joseph Priestley. . . .

Thus the development of chemistry in the city is reflected in the growth of what became the Cleveland Section of the American Chemical Society. As the rapidly expanding iron, steel, oil, and

Continued on next page

CLEVELAND—*continued*

paint industries of the mid and late nineteenth century began to require more advanced applications of chemical principles to their processes and to the development of new products, they recruited graduates from the departments of chemistry and chemical engineering at Western Reserve University and Case School of Applied Science as well as from the many smaller undergraduate colleges in and around the city. As more and more trained chemists entered the ranks of Cleveland's industries and academic institutions, they in turn became more and more involved in the wider concerns of the chemical profession. This is reflected in the Cleveland Section's publication, *Isotopics*, which during its middle fifty years represented an area of more than 250 miles in radius around metropolitan Cleveland. . . .

The extraordinary advances which greatly improve the quality of our lives are often overshadowed in the popular mind by concerns about pollution, hazardous waste, and the harmful effects of chemicals. As it moves into its second hundred years, the Cleveland Section of the ACS will do its part to develop educational programs that stress risk assessment and evaluation of the compromises that must be made between benefits and risks involved in the development and use of the products of chemistry. It is an exciting and challenging task which should make the next one hundred years as full of rich history and creative scientists as the past one hundred years have been.

FR. ERNEST G. SPITTLER, S.J.

Founding of Earliest Local ACS Sections

Year	Section	Year	Section
1891	Rhode Island	1904	Georgia
	New York	1905	Iowa
	Cincinnati		W. New York
1893	Washington, DC	1906	Indiana
	Lehigh Valley		Louisiana
1895	Chicago		Minnesota
	Nebraska		U. Illinois
1896	North Carolina	1907	St. Louis
1897	Columbus, OH		Syracuse
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	U. Michigan		Louisville
1900	Kansas City		Milwaukee
1901	California	1909	Cleveland
1902	Cornell		Puget Sound
1903	Pittsburgh		U. Missouri

VISITORS & EVENTS

On 21 June 1900 President William McKinley (center right, front) dedicated the Hahnemann Memorial on Scott Circle in Washington D.C., a few blocks from the American Chemical Society's headquarters. Also present were John W. Griggs, the attorney general; Charles E. Walton, president of the American Institute of Homeopathy; and William Tod Helmuth, the "poet of the day." Courtesy of the Archives, Hahnemann University, Philadelphia.

Conversazioni

No More Bloodletting

Ned D. Heindel of Lehigh University, president-elect of the American Chemical Society, spoke at a spring conversazione, "Chemistry and Botany in Early Pennsylvania Homeopathy." Like Edgar Fahs Smith, an ACS president and a noted lover of chemical history from an earlier generation, Heindel is a native of York, Pennsylvania. He was instrumental in steering the concept of a national history of chemistry center through the American Chemical Society, thus making possible the Chemical Heritage Foundation. He has published research articles in such disparate journals as *Bioconjugate Chemistry* and *Pennsylvania Folklife*.

Samuel Hahnemann's system of medicine was a reaction against "heroic" medicine, involving procedures such as bloodletting, leeches, and the use of calomel. His multilingual principles—"Similia similibus curantur," "Mild macht gross," and "Above all do no harm"—led him to interfere in the body's normal curative processes as little as possible. He sought for natural drugs, chemically modified if that would help, and always emphasized the importance of the spiritual operation of the healer. He was a pioneer of pharmacology—testing drugs at various dosages and carefully recording the symptoms. Among the materials he studied were comfrey, strychnine, squid extract, and American mandrake. We owe to homeopathy the use of nitroglycerin for angina, and a careful study of snake venoms. The *Correspondenzblatt der Homeopathischen Ärzte* was a form of professional communication much like today's *Tetrahedron Letters*. Of the sixteen homeopathic medical schools existing in 1908, none have survived as such, homeopathy becoming a specialty within allopathic medicine.

America and the Pacific Rim

While the Japanese study technological failures as well as successes, we in the United States tend only to look for successes to emulate. That may be one clue to Japan's spectacular advances in technology, suggested **Herbert S. Eleuterio,** former director of New Technology Studies at Du Pont Chemicals, in a CHF conversazione, "Technological Innovation, Human Creativity, and Economic Competitiveness." Eleuterio referred to developments in several Pacific rim countries, many of which he knows well. Singapore, he told us, graduates more electrical engineers per capita than

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any other country in the world. He analyzed the factors involved in a country's technological development and the phases this process goes through. Japan's efficient and effective technology transfer process is due in part to a supportive government, a well-educated work force, and a literate citizenry with a shared set of values and the national resolve to compete globally.

He suggested that the real wealth of a nation depends on the breadth and depth of its technological base—and will depend on it even more in the future.

Returning to Japan, he commented that its competitive edge in technology is probably due to attention to detail, perseverance despite rejection and failure, and affectionate care for the product.

For the CHF Chemical Engineering Timeline see page 18

Charles C. Price at Eighty

The staff of the Chemical Heritage Foundation came out in force to greet Charlie Price and his wife Anne on the occasion of his eightieth birthday. Former President of the American Chemical Society and past head of the chemistry department of the University of Pennsylvania, Price has for many years been head of the Board of Directors of CHF and its predecessors.

At the celebration of Charles Price's birthday, from the left, James Bohning, Arnold Thackray, Ethel Wanner, Theodor Benfey, Charles Price, Anne Price, Lawrence Friedman, Irene Lukoff, Elizabeth Cooper, Loretta Smith, and Ernestine Cobb.

A Chemical Engineering Centennial

The year 1992–93 marks the centennial of the University of Pennsylvania's chemical engineering department. As part of the celebration, L. E. Scriven of the University of Minnesota spoke this spring, on "Evolution of Chemical Engineering: Discipline and Profession." Scriven wrote the introductory essay, "On the Emergence and Evolution of Chemical Engineering," to Clark K. Colton's *Perspectives in Chemical Engineering* (Academic Press, 1991). The lecture was jointly sponsored by CHF and two Penn departments, Chemical Engineering and History and Sociology of Science.

Around 1880, when their industrial leadership was slipping, the British recognized the need to bring chemistry and engineering together. Scriven characterized the subsequent story as a love-hate relationship between these disciplines, and he explored the development of chemical engineering at such centers as MIT, Penn, and Caltech. He also reviewed the field's changing frontiers—heavy chemicals, organic chemicals, electrochemicals, petrochemicals, and high-pressure and catalytic processes—and ended with a discussion of the challenges of our own time.

As *Chemical Heritage* goes to press, Ralph Landau of Listwell Incorporated is to deliver the Ralph Connor lecture to mark the end of the centennial.

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LANDMARKS—*continued from p. 1*

increase professional and public awareness of chemical milestones and to encourage their preservation.

The Chemical Heritage Foundation enthusiastically supports this new initiative. The NHCLP is led by an advisory committee of chemists, chemical engineers, and historians of science and technology, many with ties to CHF, among them the chair, Jeffrey L. Sturchio of Merck & Co., Inc. (HIST chair for 1993). Readers of these pages will recognize the names and remember the services of Ernest L. Eliel (ACS past president), Ned D. Heindel (ACS president elect), Stanley I. Proctor, Jr. (AIChE past president), James R. Fair (University of Texas), Peter J. T. Morris (Science Museum, London), Mary Jo Nye (University of Oklahoma), and David Rhees (Bakken Library and Museum). Familiar from other roles are William Jensen (University of Cincinnati), James W. Long (University of Oregon), and Arthur Molella (Smithsonian). The committee's two overseas members both recently spent a year at CHF: Yasu Furukawa of Tokyo Denki University, Japan, a visiting scholar in 1992–93, and Peter Morris, Edelstein International Fellow for 1991–92.

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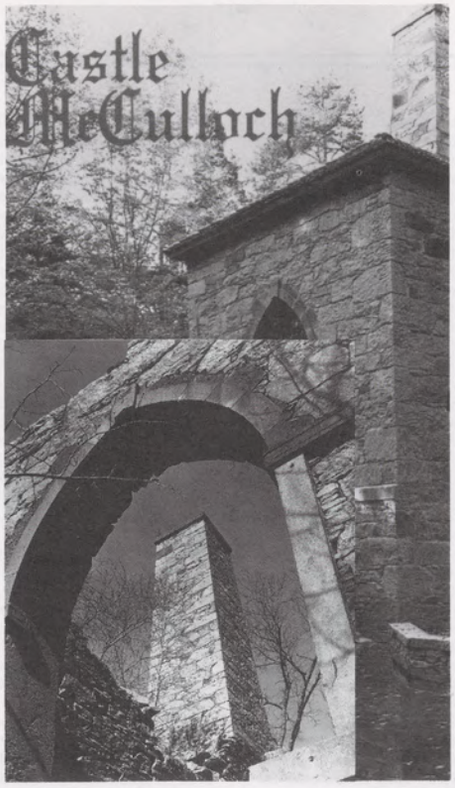
To obtain the *NHCLP Guide*, which gives the specifics for the process of identification, documentation, and nomination, write ACS Office of Public Outreach, 1155 Sixteenth Street N.W., Washington, D.C. 20036; or contact Jim Bohning at CHF.



North Carolina was a major gold-production area until the California gold rush. The Historic American Engineering Record assisted with the historical research needed to restore this steam-engine house in Jamestown, which powered the millstones used to crush the ore. The gold was extracted by mercury amalgamation. The building, dating from 1830 and in ruins in the 1970s, is now an inn. Photos courtesy J. Randall Catoe (left) and Castle McCulloch (right).

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Chemical Heritage (ISSN 0736-4555), an occasional publication of the Chemical Heritage Foundation, reports on CHF's activities and on other news of the history of chemistry, chemical engineering, and the chemical process industries. Address inquiries and information to the Editor, *Chemical Heritage*, 3401 Walnut Street, Philadelphia, PA 19104-6228 USA; tel. (215) 898-4896; fax (215) 898-3327.

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